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Bechtel Corp, San Francisco, Calif

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Second Progress Report

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The report gives results of advanced testing (from June 1975 to February 1976) of 30,000 acfm (10 MW equivalent) lime/limestone wet scrubbers for SO2 and particulate removal at TVA's Shawnee Power Station. No reliability problems were experienced in 1143 hours of lime testing with cycling gas rate to simulate variable load operation in the venturi/spray tower. Clean operation of the mist eliminator (M.E.) system (3-pass, open-vane chevron M.E. with intermittent top and bottom wash) was achieved using lime in the venturi/spray tower system, but plugging occurred with a similar M.E. system using limestone in the Turbulent Contact Absorber. In tests to improve limestone utilization, M.E. reliability was found to be a strong function of alkali utilization. In both scrubber systems, intermittent top and bottom wash kept the M.E. clean at alkali utilization greater than 85%. Below 85% alkali utilization, a continuous bottom wash was required. Limestone utilization was correlated with scrubber inlet pH, hold tank residence time, and hold tank design.

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ABSTRACT

This report presents the test results from June 1975 through mid-February 1976 of an Advanced Test Program on a prototype lime/limestone wet-scrubbing test facility for removing SO_2 and particulates from coal-fired boiler flue gases. The test facility is located at TVA's Shawnee Power Station, Paducah, Kentucky. Tests were conducted on two parallel scrubber systems, a venturi/spray tower in lime and limestone service and a Turbulent Contact Absorber (TCA) in limestone service, each with a 30,000 acfm (10 MW equivalent) flue gas capacity.

Single, three-pass, open-vane chevron mist eliminators were used in both systems. Reliable operation of the mist eliminator was found to be strongly dependent on the alkali utilization (moles SO_2 absorbed/mole Ca added). Above about 85 percent utilization, an intermittent topside and bottomside makeup water wash kept the mist eliminator clean. Below 85 percent utilization, plugging occurred, but a continuous bottomside wash with diluted clarified liquor, coupled with an intermittent topside wash with makeup water, stabilized the mist eliminator solids restriction below 10 percent. Tests were run at 9.4 and 12.5 ft/sec superficial velocity in the spray tower and TCA, respectively, and at 8 to 15 percent slurry solids concentration.

An 1143-hour, variable-load test with lime slurry in the venturi/spray tower system demonstrated that the system can be operated with good control when following a typical daily boiler load cycle.

Limestone utilization tests were conducted to correlate utilization with scrubber inlet liquor pH, hold tank residence time, and hold tank design. Utilization was unaffected by a change from 20 to 12 minutes residence time, but utilization declined at 6 minutes residence time. Three hold tanks in series improved utilization.

CONTENTS

Section		Page
1	SUMMARY	1-1
	1.1 Venturi/Spray Tower Lime Reliability Test Results	1-2
	1.2 Venturi/Spray Tower Variable-Load Test Results	1-3
	1.3 TCA Limestone Reliability Test Results	1-4
	1.4 Results of Limestone Utilization Tests in the Venturi/Spray Tower and TCA Systems	1-6
	1.5 Laboratory Quality Assurance Program	1-9
	1.6 Operating Experience During Lime/Limestone Testing	1-9
2	INTRODUCTION	2-1
3	TEST FACILITY	3-1
	3.1 Scrubber Selection	3-1
	3.2 System Description	3-3
	3.3 EPA Pilot Plant Support	3-10
4	TEST PROGRAM	4-1
	4.1 Test Program Objectives and Schedule	4-1
	4.2 Closed-Liquor-Loop Operation	4-4
	4.3 Analytical Program	4-4
	4.4 Data Acquisition and Processing	4-6
5	VENTURI/SPRAY TOWER LIME RELIABILITY TEST RESULTS	5-1
	5.1 Performance Data and Test Evaluation	5-1
	5.2 Conclusions	5-7

Section			Page
6	VENTURI/SPRAY TOWER VARIABLE-LOAD TEST RESULTS		6-1
6.1	Performance Data and Test Evaluation	6-1
6.2	Conclusions	6-7
7	TCA LIMESTONE RELIABILITY TEST RESULTS		7-1
7.1	Testing with Two Chevron Mist Eliminators in Series	7-2
7.2	Testing with a Single Chevron Mist Eliminator	7-9
7.3	Conclusions	7-16
8	LIMESTONE UTILIZATION TESTING IN THE VENTURI/SPRAY TOWER AND TCA SYSTEMS		8-1
8.1	Utilization Testing in the Venturi/Spray Tower System with Variable Residence Time	8-3
8.2	Utilization Testing in the TCA System with Three Hold Tanks in Series	8-12
8.3	Utilization Data from Depletion Runs	8-20
8.4	Mist Eliminator Operability During Limestone Utilization Testing	8-20
8.5	Conclusions	8-29
9	LABORATORY QUALITY ASSURANCE PROGRAM		9-1
9.1	Quality Assurance Criteria	9-2
9.2	Evaluation and Modifications of Analytical Procedures	9-2
9.3	Current Quality Assurance Measures	9-11

Section | Page

10 OPERATING EXPERIENCE DURING LIME/LIMESTONE TESTING 10-1
- 10.1 Scrubber Internals 10-1
- 10.2 Reheaters 10-6
- 10.3 Fans 10-7
- 10.4 Pumps 10-8
- 10.5 Waste Solids Handling 10-9
- 10.6 Alkali Addition Systems 10-11
- 10.7 Instrument Operating Experience 10-13
- 10.8 Materials and Equipment Evaluation Program 10-16

11 REFERENCES 11-1

Appendices		Page
A	Converting Units of Measure	A-1
B	Scrubber Operating Periods	B-1
C	Properties of Raw Materials	C-1
D	Data Base Tables	D-1
E	Test Results Summary Tables for the Venturi/Spray Tower	E-1
F	Graphical Operating Data from the Venturi/Spray Tower Tests	F-1
G	Average Liquor Compositions for the Venturi Spray Tower Tests	G-1
H	Test Results Summary Table for the TCA	H-1
I	Graphical Operating Data from the TCA Tests	I-1
J	Average Liquor Compositions for the TCA Tests	J-1
K	Analytical Precision and Accuracy Procedures	K-1
L	Third TVA Interim Report of Corrosion Studies	L-1

ILLUSTRATIONS

Figure		Page
3-1	Schematic of Venturi Scrubber and Spray Tower	3-4
3-2	Schematic of Three-Bed TCA Scrubber	3-5
3-3	Test Facility Mist Eliminator Configurations	3-6
3-4	Typical Process Flow Diagram for Venturi/ Spray Tower System	3-8
3-5	Typical Process Flow Diagram for TCA System	3-9
4-1	Shawnee Advanced Test Schedule	4-3
8-1	Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the Venturi/Spray Tower Tower System with a Single Hold Tank at 20 Minutes Residence Time	8-4
8-2	Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the Venturi/Spray Tower System with a Single Hold Tank at 12 Minutes Residence Time	8-5
8-3	Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the Venturi/Spray Tower System with a Single Hold Tank at 6 Minutes Residence Time	8-6
8-4	The Effect of Effluent Hold Tank Residence Time and Scrubber Inlet Liquor pH on Stoichiometric Ratio in the Venturi/ Spray Tower System	8-8
8-5	The Effect of Stoichiometric Ratio and Effluent Residence Time on Percent SO_2 Removal in the Venturi/ Spray Tower System with a Single Hold Tank	8-9
8-6	The Effect of Scrubber Inlet Liquor pH on Percent SO_2 Removal in the Venturi/Spray Tower System	8-10
8-7	The Effect of Scrubber Inlet Liquor pH and Inlet Gas SO_2 Concentration on Percent SO_2 Removal in the Venturi/Spray Tower System	8-11
8-8	Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the TCA System with a Single Hold Tank at 12 Minutes Residence Time	8-14

ILLUSTRATIONS

Figure		Page
8-9	Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the TCA System with Three Hold Tanks in Series at 14.4 Minutes Residence Time	8-15
8-10	Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the TCA System with Three Hold Tanks in Series at 10.8 Minutes Residence Time	8-16
8-11	The Effect of Scrubber Inlet Liquor pH and Hold Tank Configuration on Stoichiometric Ratio in the TCA System	8-17
8-12	The Effect of Stoichiometric Ratio and Hold Tank Configuration on Percent SO_2 Removal in the TCA System	8-19
8-13	Stoichiometric Ratio versus Scrubber Inlet Liquor pH for Depletion Test at 6 Minutes Residence Time in the Venturi/Spray Tower System	8-21
8-14	Stoichiometric Ratio versus Scrubber Inlet Liquor pH for Depletion Tests in the TCA System with Three Hold Tanks in Series at 10.8 Minutes Residence Time	8-22
8-15	Stoichiometric Ratio versus Scrubber Inlet Liquor pH for Depletion Tests in the TCA System with Three Hold Tanks in Series at 14.4 Minutes Residence Time	8-23
9-1	Results of Analysis for CaO by X-Ray Fluorescence Spectrometry with Known Values for CaO in the Prepared Samples	9-4
9-2	Results of Analysis for SO_3 by X-Ray Fluorescence Spectrometry with Known Values for SO_3 in the Prepared Samples	9-5
9-3	Results of Analysis for MgO by X-Ray Fluorescence Spectrometry with Known Values for MgO in the Prepared Sample	9-6
10-1	Failure Rate of 6-Gram TPR Spheres in Limestone/Fly Ash Slurry Service	10-3

TABLES

Table		Page
4-1	Field Methods for Batch Chemical Analysis of Slurry and Alkali Samples	4-5
8-1	Summary of Venturi/Spray Tower Limestone Utilization and Mist Eliminator Tests	8-24
8-2	Summary of TCA Limestone Utilization and Mist Eliminator Tests	8-25
10-1	Summary of Filter Cloths Tested at Shawnee	10-10

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Section 1

SUMMARY

This is the second progress report on an Advanced Test Program under the direction of the Environmental Protection Agency (EPA) to test prototype lime and limestone wet-scrubbing systems for removing sulfur dioxide and particulate matter from coal-fired boiler flue gases. It covers the period from June 1975 through mid-February 1976. Results of earlier testing have been reported in EPA-650/2-75-047 and EPA-600/2-75-050. The program is being conducted in a test facility integrated into the flue gas ductwork of Boiler No. 10 at the Tennessee Valley Authority (TVA) Shawnee Power Station, Paducah, Kentucky. Bechtel Corporation of San Francisco is the major contractor and test director, and TVA is the constructor and facility operator.

There are two parallel scrubbing systems being operated during the Advanced Test Program:

- A venturi followed by a spray tower
- A Turbulent Contact Absorber (TCA)

Each system is capable of treating approximately 10 MW equivalent (30,000 acfm* @ 300°F) of flue gas containing 1500 to 4500 ppm sulfur dioxide and 2 to 5 grains/scf of particulates.

The most significant result during this reporting period was the discovery that mist eliminator reliability improves dramatically with increase in alkali utilization (moles SO_2 absorbed/mole Ca added). Major areas of testing included:

- Reliability testing of several mist eliminator configurations with lime and limestone
- Variable load testing with lime on the venturi/spray tower
- Alkali utilization testing with limestone on both systems

1.1 VENTURI/SPRAY TOWER LIME RELIABILITY TEST RESULTS

Lime reliability tests were continued from June through August 1975 on the adjustable-throat venturi followed by a four-header spray tower. The spray tower had a three-pass, open-vane chevron mist eliminator with provision for both underside and topside intermittent washing. The mist eliminator was washed with makeup water. The underside wash rate was 1.5 gpm/ft^2 for 4 to 6 minutes every 4 hours. The

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[*] Although it is the policy of the EPA to use the metric system for quantitative descriptions, the British system is used in this report. Readers who are more accustomed to metric units are referred to the conversion table in Appendix A.

topside wash was accomplished by operating six nozzles in sequence. Every 80 minutes, one nozzle was activated for 4 minutes at a rate of 0.5 gpm/ft^2. Since the previous report, superficial gas velocity was increased to 9.4 ft/sec (the system's maximum), mist eliminator wash rate was reduced, solids concentration was increased to 15 percent, and 1075 hours of operation were logged with essentially no fouling of the mist eliminator (2 to 3 percent restriction at the end of the period).

1.2 VENTURI/SPRAY TOWER VARIABLE-LOAD TEST RESULTS

From August to October 1975, cycling gas load tests were conducted on the venturi/spray tower with lime slurry. During these tests, the gas rate was adjusted hourly to follow the daily boiler load cycle, which ranged from 60 to 160 MW. The test series was divided into two parts. The first part was a 717-hour test in which the venturi plug position was adjusted according to the varying gas flow rate to maintain a constant 9-inch H_2O pressure drop across the venturi. The second part was a 426-hour test with the venturi plug fixed at a position giving a 9-inch H_2O pressure drop across the venturi at the maximum gas flow rate of 35,000 acfm.

Throughout the 1,143 hours of operation, the system ran reliably with good control and the mist eliminator remained clean.

SO_2 removal ranged from 70 to 98 percent at inlet SO_2 concentrations of 1500 to 4400 ppm; lime utilization (moles SO_2 absorbed/mole Ca added) averaged 90 percent; and total pressure drop was 7 to 15 inches H_2O, including the mist eliminator system and 4 to 9 inches H_2O across the venturi. Sulfate (gypsum) saturation* was 90 to 100 percent .

1.3 TCA LIMESTONE RELIABILITY TEST RESULTS

1.3.1 Testing with Two Chevron Mist Eliminators in Series

During the boiler outage in May 1975, the old mist eliminator system in the TCA (washtray in series with a six-pass, closed-vane chevron mist eliminator) was replaced with a new system. The new system consisted of two identical three-pass, closed-vane, fiberglass-reinforced plastic (FRP) chevron mist eliminators in series, with provision for intermittent topside and bottomside wash of the lower mist eliminator.

A combination of intermittent topside wash with fresh water (2.0 gpm/ft^2 for 30 seconds every 10 minutes) and continuous underside wash (up to 0.45 gpm/ft^2) using diluted clarified liquor on the lower stage did not prevent solids accumulation in the mist eliminators during short runs.

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* Defined as (activity Ca^{++}) x (activity $SO4^{=}$)/(solubility product at 50°C). Estimated solubility product for $CaSO_4 \cdot 2H_2O$ at 50°C is 2.2 x 10^{-5} (Ref. Radian Corporation, "A Theoretical Description of the Limestone-Injection Wet Scrubbing Process," NAPCA Report, June 9, 1970).

At the end of an 89-hour run, the upper and lower mist eliminators were 5 percent and 8 to 10 percent restricted, respectively. Alkali utilization during these tests ranged from 65 to 85 percent. Long-term reliability runs were not attempted with this two-stage system.

1.3.2 Testing with One Chevron Mist Eliminator

Because of the success of the single-stage 316L stainless-steel, three-pass, open-vane chevron mist eliminator in lime service in the venturi/spray tower, a similar mist eliminator was fabricated and installed in the TCA. Testing of this system with limestone slurry began in July 1975 and continued through October.

In tests at both 12.5 and 9.4 ft/sec scrubber gas velocity (8.2 and 6.1 ft/sec superficial gas velocity in the enlarged mist eliminator area), plugging of the mist eliminator could not be prevented by a combination of intermittent topside and bottomside makeup water wash. This was unexpected because of the successful operation of the same mist eliminator on lime service in the venturi/spray tower. Alkali utilization ranged from 60 to 75 percent during these limestone tests. In contrast, alkali utilization is normally above 95 percent in operation with lime. Later testing revealed the strong effect of alkali utilization on mist eliminator reliability.

A combination of sequential topside wash with makeup water and continuous underside wash with diluted clarified process liquor was found to limit the buildup of solids in the mist eliminator to a steady-state level of about 10 percent restriction. Solids accumulation occurred mostly in the shadowed areas of the mist eliminator vanes and support rails not directly impinged by the underside wash liquor.

1.4 RESULTS OF LIMESTONE UTILIZATION TESTS IN THE VENTURI/SPRAY TOWER AND TCA SYSTEMS

From October 1975 through mid-February 1976, limestone tests were conducted on both the venturi/spray tower and the TCA to explore for methods of improving the utilization of the limestone feed (moles SO_2 absorbed/mole Ca added). The results of a TVA economic study showed that improved limestone utilization would significantly improve the process economics. Limestone utilization on both systems normally varied from about 60 percent at a scrubber inlet liquor pH of 6.0 to about 95 percent at a scrubber inlet liquor pH of 5.2.

Operation at the lower scrubber inlet liquor pH values, however, caused a reduction in SO_2 removal efficiency. For instance, at 2500 to 3500 ppm inlet SO_2 concentration, SO_2 removal in the venturi/spray tower system was about 88 percent at a scrubber inlet liquor pH of 6.0 and 55 percent at a pH of 5.2. But tests demonstrated that improved

SO_2 removal at high limestone utilization can be achieved by using three hold tanks in series or by adding MgO to the scrubber slurry. These tests will be described later.

1.4.1 Utilization Testing in the Venturi/Spray Tower System with Variable Residence Time

In the venturi/spray tower system, limestone tests were conducted with a single backmix effluent hold tank at residence times of 20, 12, and 6 minutes. Below a scrubber inlet liquor pH of about 5.8, limestone utilization tended to be higher at 12 to 20 minutes residence time than at 6 minutes residence time. Above a pH of 5.8, the scatter in the data was too great to draw a conclusion.

1.4.2 Utilization Testing in the TCA System with Three Hold Tanks in Series

In the TCA system, limestone tests were conducted with a single stirred hold tank and with three stirred tanks in series to approximate plug flow reaction. Kinetic theory predicts that raw materials utilization should improve with the series hold tanks.

Within the range of total effluent residence times tested (10.8 to 14.4 minutes) and at scrubber inlet liquor pH values greater than about 5.0, higher limestone utilization was achieved with three hold tanks in series than with a single hold tank. For example, at a pH of 5.7, limestone utilization increased from 79 percent with a single hold tank to 87 percent with three hold tanks in series.

1.4.3 Mist Eliminator Operability During Limestone Utilization Testing

The most significant discovery during this reporting period was that the reliability of the mist elimination system was a strong function of alkali utilization. During the limestone utilization testing period, both the venturi/spray tower and the TCA had single-stage, 316L stainless-steel, three-pass, open-vane chevron mist eliminators.

For alkali utilization greater than about 85 percent, the mist eliminators were kept free of solids deposits by an intermittent top wash with makeup water combined with either intermittent bottom wash with makeup water or continuous bottom wash with diluted clarified liquor.

For alkali utilization less than about 85 percent, intermittent top and bottomside wash with makeup water did not limit solids accumulation. However, for these conditions, a continuous bottom wash of diluted clarified liquor used in combination with an intermittent topside wash with makeup water limited the restriction within the mist eliminator due to soft solids buildup to less than 10 percent. With this wash configuration, soft solids quickly accumulated to a maximum restriction, which did not change for the duration of the run.

1.5 LABORATORY QUALITY ASSURANCE PROGRAM

Because of the increased emphasis on chemical analysis during the advanced test program, a laboratory quality assurance program was initiated. As a result of this quality assurance program, several analytical methods have been modified or replaced. All methods have been documented in the Shawnee Chemical Procedures Laboratory Manual, which is available on request.

Major areas in which revised analytical procedures have been introduced are:

- X-ray spectrometry analysis for calcium, total sulfur, and magnesium in solid samples
- Measurements of the pH of the scrubber slurry
- Amperometric titration of sulfite

1.6 OPERATING EXPERIENCE DURING LIME/LIMESTONE TESTING

Mist elimination systems have already been discussed. This subsection covers other aspects of scrubber system operations.

1.6.1 Scrubber Internals

Beginning in June 1975, 6-gram thermoplastic rubber (TPR) spheres were used in the TCA. Dimpling appeared to be about the same as with the previously used 5-gram spheres. After 3800 hours of testing, about 11 percent of the 6-gram spheres had failed from splitting at the seams. The average weight loss for the unsplit spheres was 10 percent.

In December 1975, the hollow TPR spheres were replaced with 6.5-gram nitrile solid foam spheres. After the initial 240 hours of operation, the spheres had shrunk to about 91 percent of their original diameter but had lost only 1 percent of their original weight. No additional change in weight or diameter was noted in an inspection at 574 hours. A new batch of nitrile foam spheres made by a modified manufacturing procedure was installed in early February 1976. These spheres did not experience an initial shrinkage. Quantitative data will be given in the next progress report.

The 316 stainless-steel bar grids in the TCA have exhibited no erosion after 16,000 hours of operation. The 316 stainless-steel slurry spray nozzles, operating with 15 percent slurry solids at 5 psi pressure drop, have shown no evidence of erosion after 9000 hours of operation.

In the spray tower, stellite tips on the spray nozzles, operating with 8 to 15 percent slurry solids at 10 psi pressure drop, lost 40 percent of their original weight during 11,700 hours of service. Wear was greater during periods of operation with limestone than during periods of operation with lime. The 316 stainless-steel reducers connecting the nozzles to the headers have worn badly. Occasionally the reducers have worn through and the nozzles have fallen off.

Both neoprene rubber and Flakeline 103 linings used on equipment in contact with the scrubber slurry have continued to demonstrate excellent resistance to erosion and deterioration. However, a Flakeline 103 test panel-mounted inside one of the TCA beds was significantly eroded.

1.6.2 Reheaters

The fuel-oil-fired external combustion reheaters have operated reliably for over 13,700 hours on the venturi/spray tower system and 4400 hours on the TCA system.

1.6.3 Fans

There has been no system downtime due to fan problems during this reporting period. A crack on the venturi/spray tower fan rotor shroud was repaired during the May 1975 boiler outage.

1.6.4 Pumps

Pump seal failures have continued to be a problem. The frequency of repacking on the 20 to 100 gpm pumps has been minimized by maintaining the clearance between the shaft and the packing gland at 10 to 15 mils. Two mechanical seals have been tested on slurry bleed pumps. One failed after 1500 hours of service, but the other was still in operation at 4000 hours of service.

1.6.5 Waste Solids Handling

The rotary-drum vacuum filter has continued to suffer from short cloth life: the longest cloth life during this reporting period was 642 hours of service. Since the last major resurfacing of internals, the centrifuge has logged 3500 hours of satisfactory intermittent operation, and since the feedwell was extended during the May 1975 boiler outage, the TCA clarifier has had fewer upsets.

1.6.6 Alkali Addition Systems

The lime addition system has operated reliably for over 15,800 hours of intermittent operation. The only significant problems have been occasional slaker screen blinding and grit plugs in the feed pipe. The limestone addition system has operated satisfactorily for the 4-year life of of the program. The alkali addition system pumps are Moyno positive displacement pumps. Typical operating life for a pump rotor was 2000 hours and for a stator, 1000 hours.

1.6.7 Instruments

Scale formation on the submersible pH probes has occasionally caused measurement error. This problem has been minimized by routinely rinsing with water about twice a week and recalibrating when necessary.

Adiprene-L liner failures in the 1-1/2-inch magnetic flow meters were caused by a tapered thickness near the meter exit. No more failures have occurred since the meters were relined with Adiprene-L of uniform thickness.

Slurry tank level indication has continued to be a problem. Problems with the Brooks Maglink level indicators have included jamming of the float by floating materials, flush liquor depressing the float and causing reading error, and uncoupling of the float from the magnet. However, when properly maintained and calibrated, the Brooks level indicator does measure effluent hold tank level to within ± 6 inches.

The Du Pont UV SO_2 analyzers have operated trouble-free.

1.6.8 Mechanical Components Evaluation

Selected mechanical components have been continually evaluated at the Shawnee Test Facility. These include plastic pipe, butterfly and knife gate valves, line strainers, mechanical seals, an orifice plate, and several Ceilcote lining materials.

Section 2

INTRODUCTION

In June 1968, a program was initiated under the direction of the Environmental Protection Agency (EPA)* to test a prototype lime and limestone wet-scrubbing system for removing sulfur dioxide and particulates from flue gases. The system was integrated into the flue gas ductwork of a coal-fired boiler at the Tennessee Valley Authority (TVA) Shawnee Power Station, Paducah, Kentucky. Bechtel Corporation of San Francisco was the major contractor and test director, and TVA was the constructor and facility operator.

The test facility consisted of three parallel scrubber systems: a venturi followed by a spray tower, a Turbulent Contact Absorber (TCA), and a Marble-Bed Absorber. Each system was capable of treating approximately 10 MW equivalent (30,000 acfm @ 300°F) of flue gas containing 1500 to 4500 ppm sulfur dioxide and 2 to 5 grains/scf of particulates.

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[*] The National Air Pollution Control Administration prior to 1970

The results of testing at the facility during the original program, which lasted from March 1972 to October 1974, are presented in Reference 1. The most significant reliability problem encountered during this testing period was associated with scaling and/or plugging of mist elimination surfaces. The TCA mist elimination system consisted of a washtray in series with a chevron mist eliminator, both with underside washing. Long-term operability of this system was demonstrated in limestone service in an 1835-hour test at a scrubber gas velocity of 8.6 ft/sec.* The venturi/spray tower mist elimination system consisted of a chevron mist eliminator with underside washing. At the end of the original testing program, long-term operability of the venturi/spray tower system had not been demonstrated. Operation of the Marble-Bed Absorber was discontinued in July 1973 (see Reference 1).

In June 1974, the EPA, through its Office of Research and Development and Control Systems Laboratory, initiated a 3-year Advanced Test Program at the Shawnee Facility. Bechtel Corporation continued as the major contractor and test director, and TVA as the constructor and facility operator.

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* In this report, all gas velocities and liquid-to-gas ratios are at scrubber operating conditions, i.e., saturated gas at scrubber temperature. With flue gas operations, the scrubber temperature is approximately 125^{o}F. The gas velocities are all superficial velocities.

The major goals established for the advanced program were:

- To continue long-term testing with emphasis on demonstrating reliable operation of the mist elimination systems
- To investigate advanced process and equipment design variations for improving system reliability and process economics
- To perform long-term (2- to 5-month) reliability testing on promising process and equipment design variations

The results of advanced testing from October 1974 through April 1975 at the Shawnee Facility are presented in Reference 2. Successful operation of a chevron mist eliminator with intermittent top and bottom wash was demonstrated in the venturi/spray tower system in lime service at 8.0 ft/sec. In the TCA in limestone service, plugging of the combined washtray/mist eliminator system could not be prevented at velocities greater than 8.6 ft/sec. Tests were interrupted in May 1975 owing to a 6-week scheduled maintenance outage on Boiler No. 10.

This report presents the results of advanced testing at the Shawnee Facility from June 1975 through mid-February 1976. During this period, the TCA was operated on limestone. Mist eliminator testing was continued (see Reference 2), and the use of one- and two-stage systems, different wash configurations, and different alkali utilization levels was evaluated.

The venturi/spray tower was operated on both lime and limestone. Mist eliminator tests and variable-gas-load tests were run with lime. With limestone, mist eliminator tests and alkali utilization tests were run.

Section 3

TEST FACILITY

Two parallel scrubbing systems are being operated during the Advanced Test Program. Scrubbers incorporated in these systems are:

- A venturi followed by a spray tower
- A Turbulent Contact Absorber (TCA)

Each system operates independently and is capable of treating approximately 30,000 acfm of flue gas from the TVA Shawnee coal-fired Boiler No. 10. This gas rate is equivalent to approximately 10 MW of power plant capacity.

Boiler No. 10 normally burns a medium- to high-sulfur bituminous coal which produces SO_2 concentrations of 1500 to 4500 ppm and inlet particulate loadings of 2 to 5 grains/scf in the flue gas.

3.1 SCRUBBER SELECTION

The major criterion for scrubber selection was the potential for removing both sulfur dioxide and particulates at high efficiencies (defined for the Shawnee Facility as sulfur dioxide removal greater than 80 percent and particulate removal greater than 99 percent). Other criteria considered in the selection of the scrubbers were:

- Ability to handle slurries without plugging or excessive scaling
- Reasonable cost and maintenance
- Ease of control
- Reasonable pressure drop

The venturi/spray tower and the TCA were chosen to meet these criteria.

The adjustable-throat venturi scrubber in the venturi/spray tower system was manufactured by Chemical Construction Company. The venturi scrubber removes the bulk of the particulates. But because the residence time in a venturi scrubber is low, the scrubber with lime/limestone slurry removes less than half of the SO_2. The spray tower that follows the venturi scrubber provides sufficient residence time for the removal of most of the remaining SO_2.

The TCA was manufactured by Universal Oil Products. It operates with beds of nominal 1-1/2-inch-diameter low-density spheres that are free to move between retaining grids. As the incoming flue gas contacts the slurry in these beds, both SO_2 and particulates are removed.

Figures 3-1 and 3-2 (drawn with major dimensions to scale) show the two scrubber systems and the typical mist elimination systems selected for deentraining slurry in the exit gas streams. The chevron mist eliminators used during the testing on the two scrubber systems are depicted, to scale, in Figure 3-3. The cross-sectional area of the TCA scrubber is 32 ft^2 in the scrubbing section and 49 ft^2 in the mist elimination section. The cross-sectional area of the spray tower is 50 ft^2 in both the scrubbing section and the mist elimination section.

3.2 SYSTEM DESCRIPTION

The Shawnee Test Facility contains five major areas:

- The scrubber area (including tanks and pumps)
- The operations building area (including laboratory area, electrical gear, centrifuge, and filter)
- The thickener area (including tanks and pumps)
- The utility area (including air compressors, air dryer, limestone storage silos, mix tanks, gravimetric feeder, and pumps)
- The pond area

The test facility has been so designed that a number of different scrubber internals and piping configurations can be used with each scrubber system. For example, the TCA scrubber can be operated with one, two, or three beds of spheres or with only the support grids. Waste

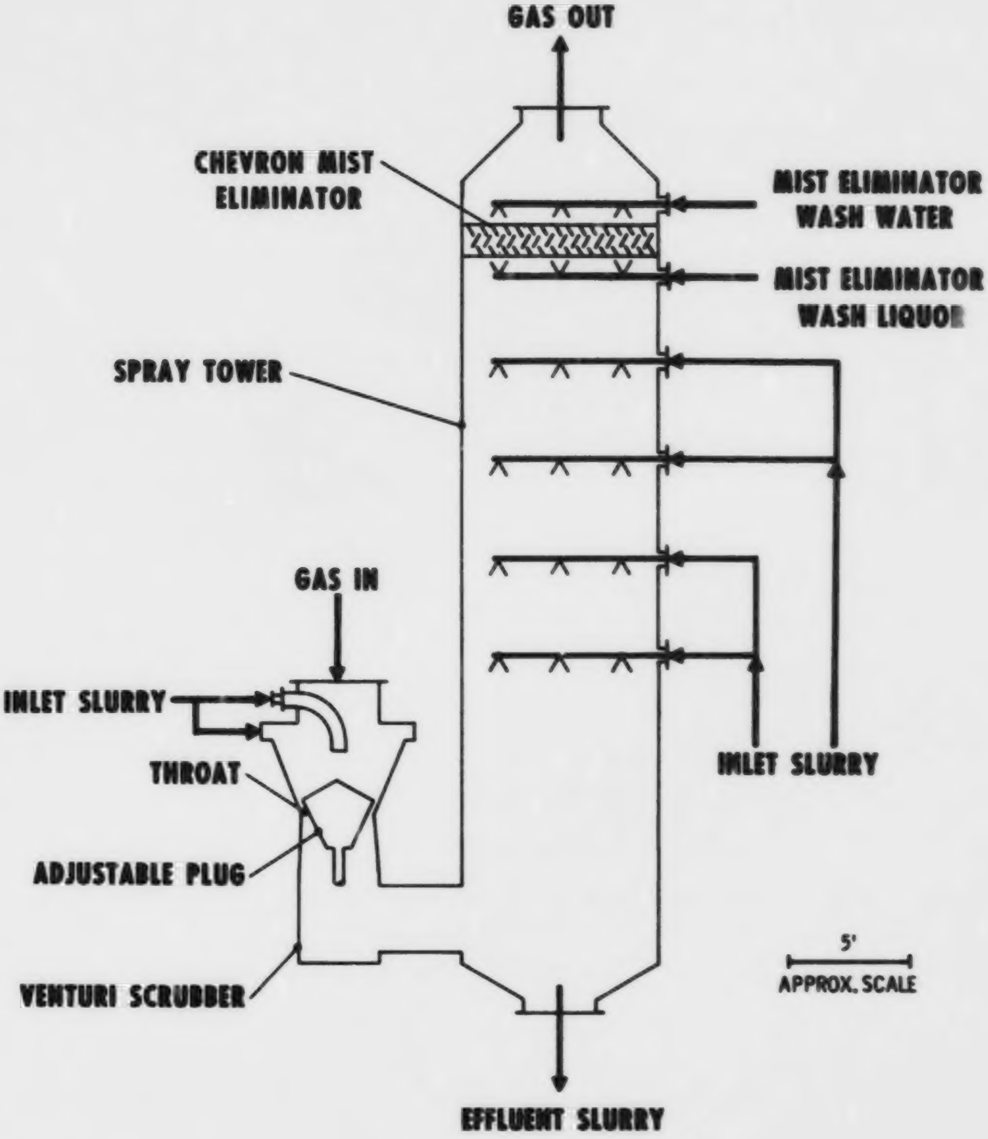
GAS OUT
CHEVRON MIST ELIMINATOR
MIST ELIMINATOR WASH WATER
MIST ELIMINATOR WASH LIQUOR
SPRAY TOWER
GAS IN
INLET SLURRY
THROAT
ADJUSTABLE PLUG
VENTURI SCRUBBER
INLET SLURRY
5'
APPROX. SCALE
EFFLUENT SLURRY

Figure 3-1. Schematic of Venturi Scrubber and Spray Tower

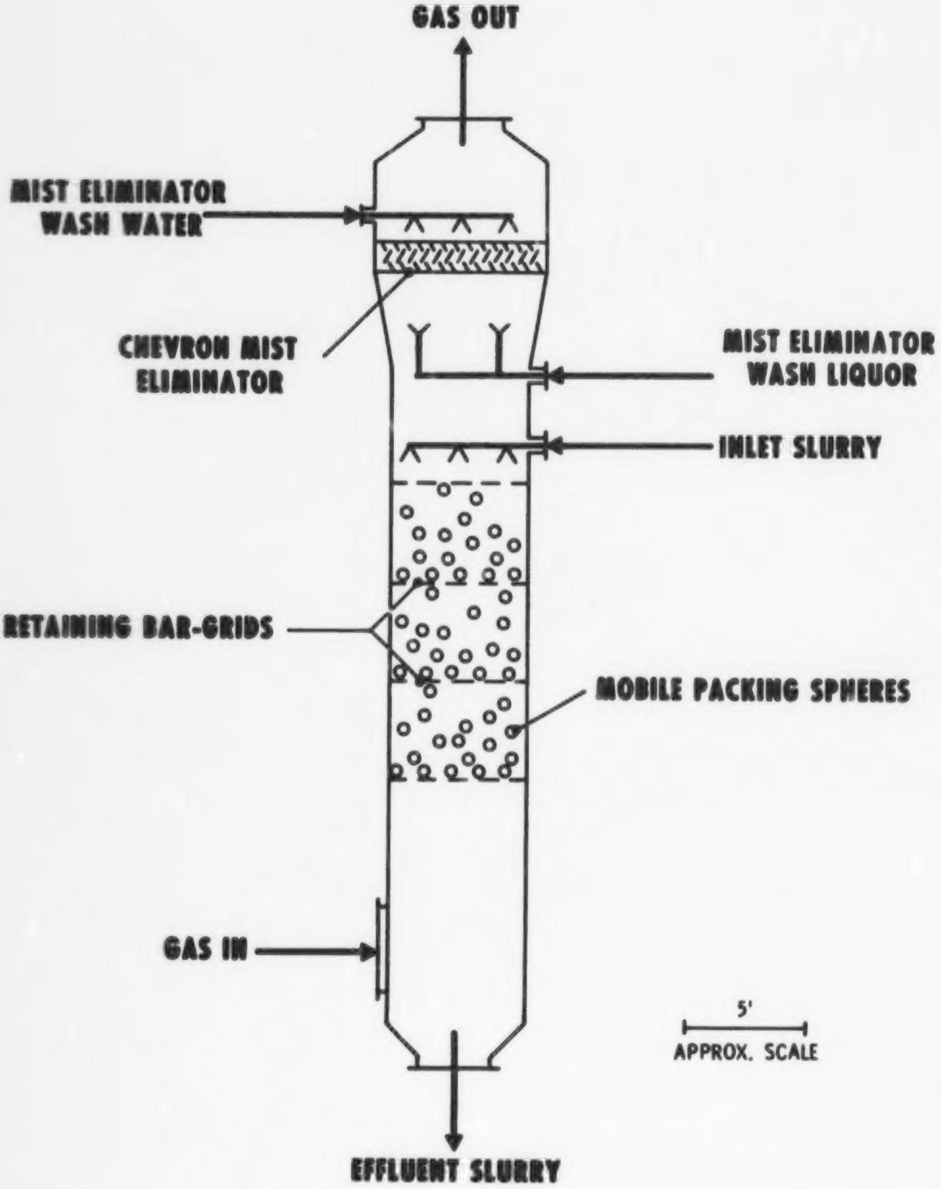
GAS OUT
MIST ELIMINATOR WASH WATER
CHEVRON MIST ELIMINATOR
MIST ELIMINATOR WASH LIQUOR
INLET SLURRY
RETAINING BAR-GRIDS
MOBILE PACKING SPHERES
GAS IN
5'
APPROX. SCALE
EFFLUENT SLURRY

Figure 3-2. Schematic of Three-Bed TCA

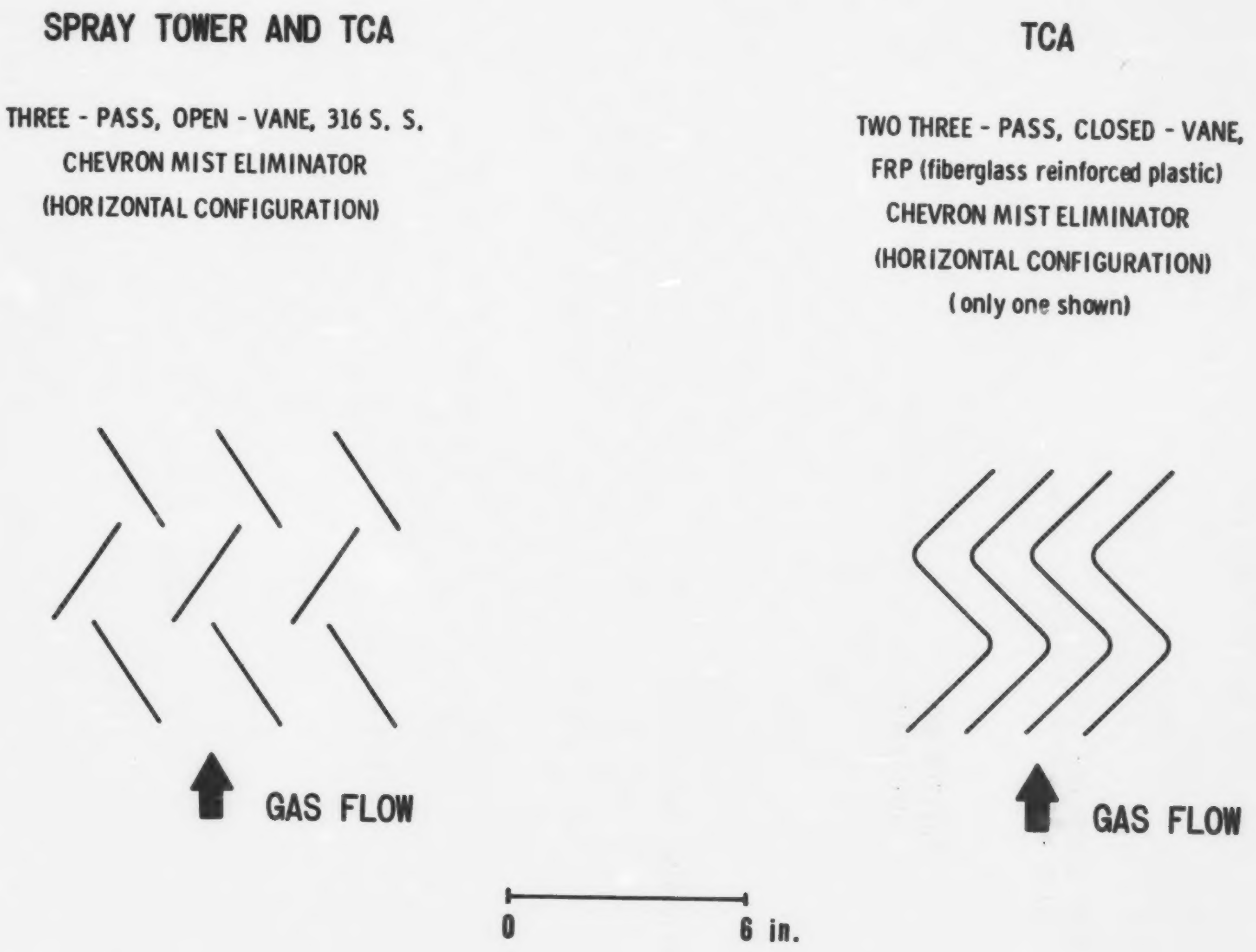
SPRAY TOWER AND TCA
THREE - PASS, OPEN - VANE, 316 S. S.
CHEVRON MIST ELIMINATOR
(HORIZONTAL CONFIGURATION)
GAS FLOW
TCA
TWO THREE - PASS, CLOSED - VANE,
FRP (fiberglass reinforced plastic)
CHEVRON MIST ELIMINATOR
(HORIZONTAL CONFIGURATION)
(only one shown)
GAS FLOW
0
6 in.

Figure 3-3. Test Facility Mist Eliminator Configurations

solids separation can be achieved with a clarifier alone or with a clarifier in combination with a filter or a centrifuge. Either system can be operated with a single backmix hold tank or with up to three tanks in series.

Typical system configurations depicting lime testing with the venturi/ spray tower and limestone testing with the TCA scrubber are illustrated schematically in Figures 3-4 and 3-5, respectively. Such process details as flue gas saturation (humidification) sprays are not shown.

For both systems, gas is withdrawn from the boiler ahead of the steam plant particulate removal equipment so that all the entrained particulate matter (fly ash) can be introduced into the scrubber. The gas flow rate to each scrubber is measured by venturi flow meters and controlled by dampers on the induced-draft fans. The concentration of sulfur dioxide in the inlet and outlet gas streams is monitored continuously by Du Pont photometric analyzers.

The scrubbing systems are controlled from a central graphic panelboard where all significant process variables are on digital display. Important process control variables are continuously recorded. Trend recorders are provided for periodic monitoring of selected data sources. Chemical composition of major streams and scrubber inlet liquor pH are determined several times a shift.

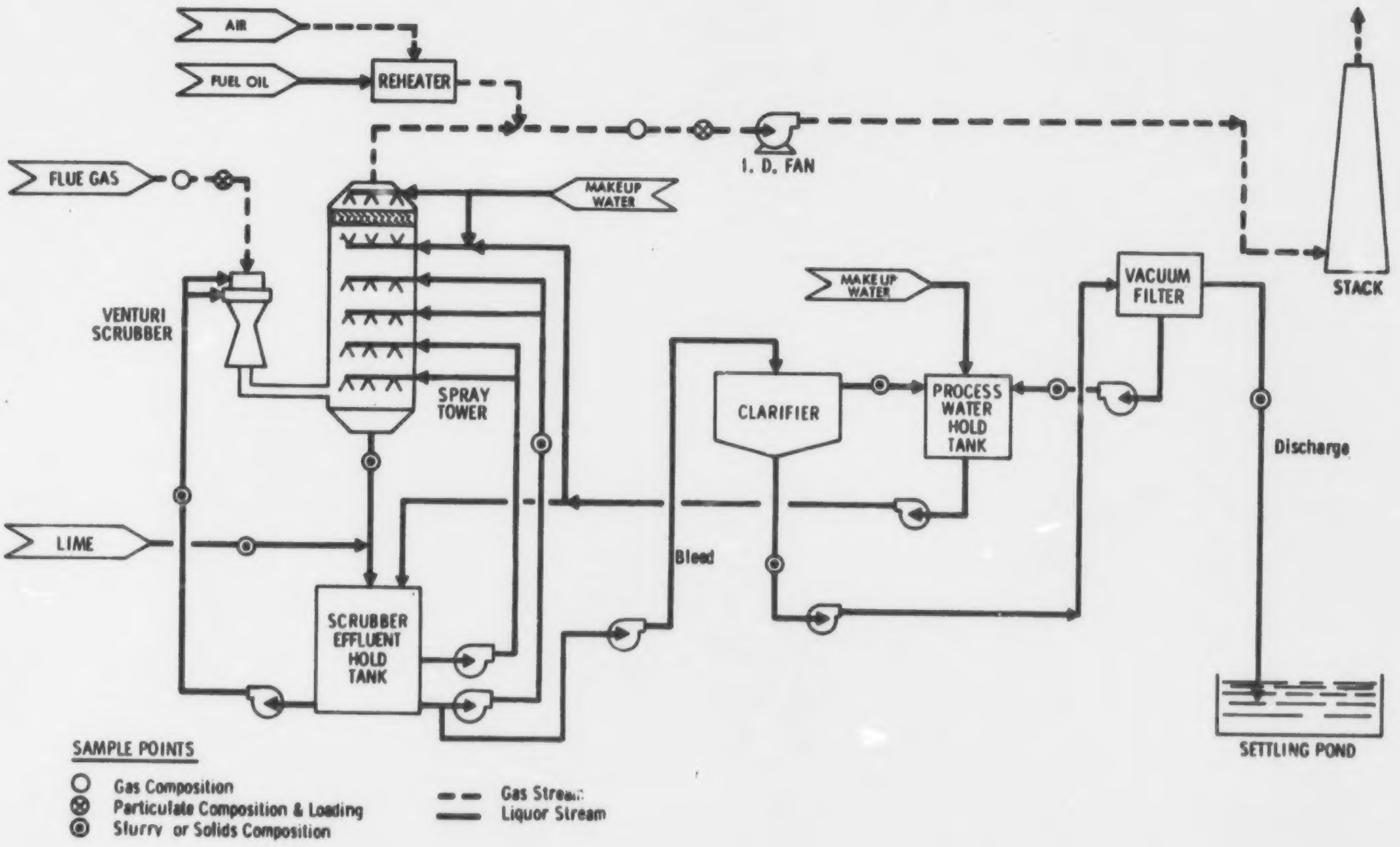
AIR
FUEL OIL
REHEATER
I. D. FAN
STACK
FLUE GAS
MAKEUP WATER
VENTURI SCRUBBER
SPRAY TOWER
MAKEUP WATER
VACUUM FILTER
CLARIFIER
PROCESS WATER HOLD TANK
Discharge
LIME
Bleed
SCRUBBER EFFLUENT HOLD TANK
SETTLING POND
SAMPLE POINTS
○ Gas Composition
⊗ Particulate Composition & Loading
◉ Slurry or Solids Composition
Gas Stream
Liquor Stream

Figure 3-4. Typical Process Flow Diagram for Venturi/Spray Tower System

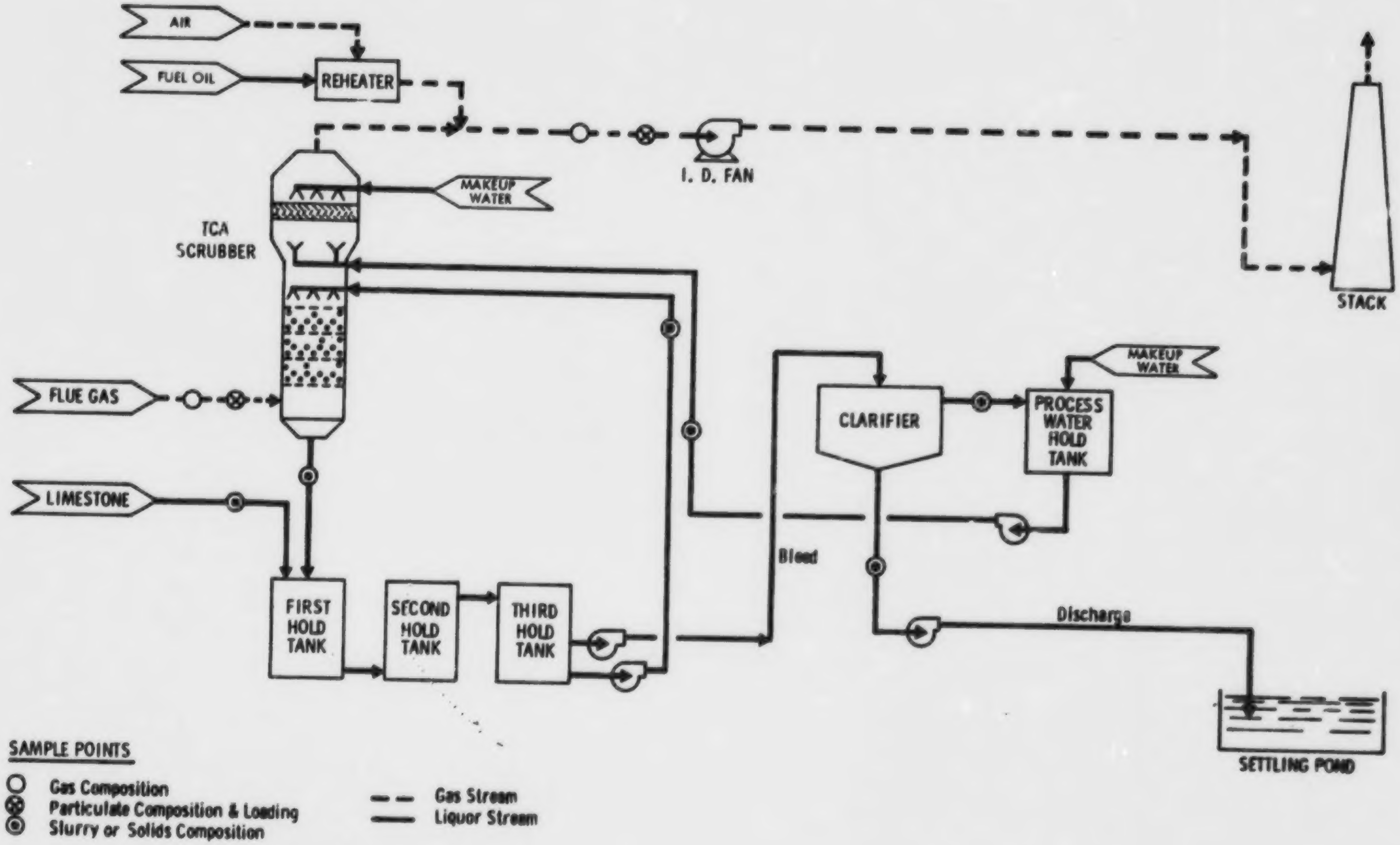
AIR
FUEL OIL
REHEATER
I. D. FAN
STACK
MAKEUP WATER
TCA SCRUBBER
FLUE GAS
LIMESTONE
FIRST HOLD TANK
SECOND HOLD TANK
THIRD HOLD TANK
Bleed
CLARIFIER
MAKEUP WATER
PROCESS WATER HOLD TANK
Discharge
SETTLING POND
SAMPLE POINTS
○ Gas Composition
⊗ Particulate Composition & Loading
⊙ Slurry or Solids Composition
- - Gas Stream
— Liquor Stream

Figure 3-5. Typical Process Flow Diagram for TCA System

3.3 EPA PILOT PLANT SUPPORT

There are two smaller scrubbing systems (300 acfm each) at the EPA Industrial Environmental Research Laborabory in Research Triangle Park, North Carolina. These small, pilot-scale scrubber systems are capable of simulating the Shawnee scrubber systems with excellent agreement in the lime/limestone wet-scrubbing chemistry. Preliminary data are generated on the pilot-scale system to verify and guide the selection of those promising concepts that should logically be investigated on the larger scale Shawnee units. Some of the results from the support program have been presented in References 4 and 5.

Section 4

TEST PROGRAM

This section contains a description of the Shawnee Advanced Test Program, which is tentatively scheduled to run from June 1974 through December 1977.

4.1 TEST PROGRAM OBJECTIVES AND SCHEDULE

The objectives of the Advanced Test Program are:

- To demonstrate process reliability with an emphasis on mist elimination systems
- To investigate advanced process and equipment design variations for improving system reliability and economics
- To evaluate process variations for a substantial increase in alkali utilization for limestone systems
- To evaluate the effect of increased magnesium ion concentration on improving control, reducing gypsum saturation, and increasing SO_2 removal
- To evaluate the efficiency and reliability of lime and limestone scrubbers under conditions of widely varying flue gas flow rate and inlet sulfur dioxide concentration
- To evaluate system performance and reliability without fly ash in the flue gas

- To determine the effectiveness of forced oxidation for producing an improved throwaway sludge product
- To determine the practical upper limits of sulfur dioxide removal efficiency for both limestone and lime scrubbing systems
- To evaluate the TCA performance with lime and the venturi/spray tower performance with limestone
- To perform long-term (2- to 5-month) reliability demonstration runs on advanced process and equipment design variations
- To characterize stack gas emissions, including outlet particulate mass loading and size distribution, slurry entrainment, and total sulfate emissions
- To evaluate methods of automatic control
- To advise on the field evaluation of three commercially offered sludge fixation processes. Aerospace Corporation is the major contractor and test director for this effort
- To evaluate, under the direction of TVA, corrosion and wear of alternative plant equipment components and materials
- To develop a computer program, in conjunction with TVA, for the design and cost comparison of full-scale lime and limestone systems

The test program schedule based on the defined objectives is presented in Figure 4-1. The period covered by the Second Progress Report extended from June 1975 through mid-February 1976. In the TCA during this period, mist eliminator testing and alkali utilization testing were conducted with limestone slurry. In the venturi/spray tower, mist eliminator testing and variable-load testing were conducted with lime slurry, and alkali utilization testing was conducted with limestone slurry.

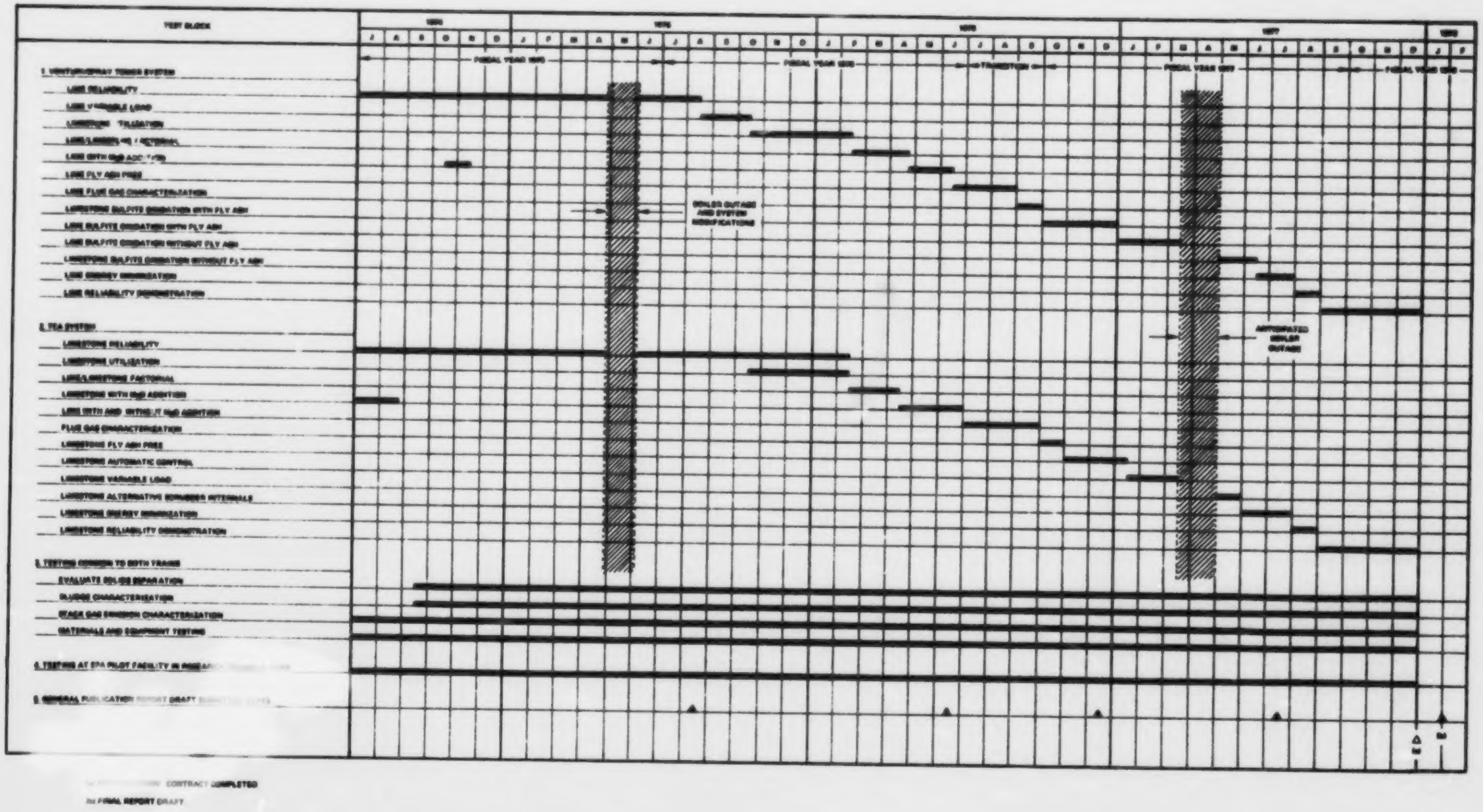

Figure 4-1. Shawnee Advanced Test Schedule

4.2 CLOSED-LIQUOR-LOOP OPERATION

A closed liquor loop is achieved when the makeup-water input to the system is equal to the water normally exiting the system in the settled sludge and in the humidified flue gas. In this report, it was assumed that a closed liquor loop is achieved when the solids concentration of the purged sludge is 38 percent by weight or higher and no separate liquor purge is taken. With few exceptions, the advanced program tests are being conducted in closed-liquor-loop operation. The exceptions are typically short exploratory runs with limited objectives. Such tests are noted when they occur.

4.3 ANALYTICAL PROGRAM

During the testing, samples of slurry, flue gas, limestone, lime, and coal are taken periodically for chemical analyses, and samples of flue gas are taken for particulate mass loading determinations. The locations of slurry and gas sample points are shown on Figures 3-4 and 3-5. A summary of the analytical methods for determining important species in the slurry solids and slurry liquor is presented in Table 4-1. A laboratory procedures manual (Reference 6) was issued in March 1976. A listing of the compositions of the raw materials used in the testing program is presented in Appendix B.

Table 4-1

FIELD METHODS FOR BATCH CHEMICAL ANALYSIS OF SLURRY AND ALKALI SAMPLES

SPECIES	FIELD METHODS			
	SOLIDS		LIQUIDS	
	Primary Method	Backup Method	Primary Method	Backup Method
Sodium	-	-	Atomic absorption	-
Potassium	-	-	Atomic absorption	-
Calcium	X-ray fluorescence	Atomic absorption	Atomic absorption	-
Magnesium	X-ray fluorescence	Atomic absorption	Atomic absorption	-
Sulfite	Amperometric titration	-	Amperometric titration	-
Total sulfur	X-ray fluorescence	$Ba(ClO_4)_2$ titration	$Ba(ClO_4)_2$ titration	-
Carbonate	CO_2 evoloution		Nondispersive infrared	Acid-base titration
Chloride	-	-	Potentiometric titration	Mercuric nitrate titration

Four Du Pont photometric analyzers are used for continuous SO_2 gas analyzing at the inlets and outlets of both scrubbers. Values of pH are monitored with Universal Interloc pH analyzers. Scrubber inlet liquor pH is monitored continuously; scrubber outlet liquor pH is monitored periodically by the laboratory. A modified EPA particulate train (manufactured by Aerotherm/Acurex Corporation) is used to measure mass loading at scrubber inlets and outlets.

4.4 DATA ACQUISITION AND PROCESSING

Data recorded by onsite personnel are sent to the Bechtel Corporation offices in San Francisco for processing. Data received from the test facility are entered into a computerized data base in San Francisco. The data are sorted, further calculations made (e.g., percent sulfite oxidation, stoichiometric ratio), and reports prepared that present the data covering a specified period for a given scrubber. The data base reports for June 1975 through mid-February 1976 are presented in Appendix D.

4.4.1 Analytical Data

The analytical data acquisition system, which records the results of laboratory analyses on printed summary sheets, was designed and (in part) installed by Radian Corporation. A minicomputer is used to perform certain calculations and print the resultant data on a summary sheet, which is then transferred to San Francisco for inclusion in the master data base.

Section 5

VENTURI/SPRAY TOWER LIME RELIABILITY TEST RESULTS

Performance and analytical data from reliability testing with lime on the venturi/spray tower system from June through August 1975 (Runs 625-1A through 627-1A) are presented in this section. An evaluation of each test and the conclusions drawn to date are also presented. Results of lime reliability tests conducted prior to June 1975 (Runs 601-1A through 624-1A) have been reported in References 1 and 2.

5.1 PERFORMANCE DATA AND TEST EVALUATION

Properties of lime and coal used during these tests can be found in Appendix B. A log of the scrubber operating periods is given in Appendix C. Appendix D tabulates analytical data. Reliability test conditions and results are summarized in Appendix E* (V/ST Summary Tables for Runs 601-1A through 627-1A). Selected operating data are graphically presented in Appendix F. Average scrubber and clarifier overflow liquor compositions and the corresponding calculated percent sulfate (gypsum) saturations are given in Appendix G.* An evaluation and discussion of each test is presented below.

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* Lime reliability runs made prior to June 1975 have been included in in this table.

5.1.1 Venturi/Spray Tower Run 625-1A

Venturi/spray tower lime Run 625-1A was started on June 20, 1975, to continue testing the 316L stainless-steel, three-pass, open-vane chevron mist eliminator. This testing had been interrupted by a 6-week scheduled maintenance outage on Boiler No. 10.

The major test conditions selected were (see Appendix E):

Spray tower gas velocity	8.0 ft/sec
Venturi liquid-to-gas ratio	25 gal/Mcf
Spray tower liquid-to-gas ratio	50 gal/Mcf
Percent solids recirculated	8
Effluent residence time	12 min
Scrubber inlet slurry pH (controlled)	8

During the test, the topside of the mist eliminator was washed sequentially with makeup water with six spray nozzles on a 4 minute "on," 76 minute "off" time cycle, with only one nozzle activated during each "on" cycle. This arrangement resulted in an 8-hour total cycle time for the six nozzles. The makeup water flow rate through one nozzle during the "on" cycle was set at 8 gpm (at 13 psig), covering about a 15 ft^2 area to give a specific spray rate of 0.5 gpm/ft^2.

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* The degree of liquor saturation with $CaSO_4 \cdot 2H_2O$ at 50°C was calculated with the use of the Bechtel Modified Radian Equilibrium Computer Program. See Reference 1 for a listing of this program.

In addition to the sequential topside wash, the entire underside of the mist eliminator was washed intermittently with makeup water at 75 gpm (1.5 gpm/ft^2) using 10 nozzles at 50 psig for 4.3 minutes every 4 hours.

The 75 gpm wash rate was only one-half of that used during the previous run (Run 624-1A) in which the mist eliminator was entirely clean after 823 hours of operation (see Appendix E). The combined makeup water usage for the topside and bottomside mist eliminator wash during Run 625-1A was only about half the makeup water available in closed-liquor-loop operation.

Run 625-1A was ended on July 9, 1975, after 319 hours of operation The mist eliminator was essentially clean (less than 2 percent restricted, as estimated by a visual inspection), with only a lightly scattered dust coating on the vanes.

Some scale was noticed on the spray tower wall below the top slurry spray header and on the wall above the mist eliminator. However, these scale deposits did not influence the spray tower operation.

The venturi section operated without trouble. The only scale observed was a uniform coating whose thickness did not exceed 50 mils over the rubber surface below the throat and in the flooded elbow section. No large solids deposits accumulated in the flooded elbow.

The calculated average sulfate (gypsum) saturation was 115 percent for the scrubber inlet liquor and 150 percent for the scrubber outlet liquor. Alkali utilization averaged 89 percent. Over an inlet SO_2 concentration range of 2000 to 3350 ppm, SO_2 removal ranged from 67 to 90 percent.

5.1.2 Venturi/Spray Tower Run 626-1A

Run 626-1A began on July 9 and ended on August 4, 1975 after 569 operating hours. The scrubber system was not cleaned before the start of the run. The purpose of the run was to test the mist eliminator reliability at 9.4 ft/sec spray tower gas velocity (versus 8.0 ft/sec for Run 625-1A). The spray tower slurry rate was increased to 1400 gpm (versus 1200 gpm for Run 625-1A) to improve the SO_2 removal efficiency. These changes resulted in liquid-to-gas ratios of 21 and 50 gal/Mcf for the venturi and spray tower, respectively. The "on" phase of the mist eliminator bottom wash cycle was increased to 6 minutes every 4 hours (versus 4.3 minutes for Run 625-1A).

The run ended as planned. The mist eliminator condition was almost unchanged during the run (less than 2 percent restricted).

The spray tower wall below the top slurry spray header had acquired more scale, which at the end of the run averaged about 100 mils in thickness.

The wall area above the mist eliminator gained additional hard scale. The venturi scrubber was generally clean.

The average calculated sulfate (gypsum) saturation was 100 percent for the scrubber inlet liquor, compared with 115 percent for Run 625-1A. Alkali utilization averaged 85 percent. Over an inlet SO_2 concentration range of 1750 to 3250 ppm, SO_2 removal was 68 to 88 percent.

5.1.3 Venturi/Spray Tower Run 627-1A

Run 627-1A was started on August 5 and ended on August 13, 1975, after 187 hours of operation. The purpose of this run was to test the mist eliminator operability at 9.4 ft/sec spray tower gas velocity with the recirculated solids increased to 15 weight percent. The effluent residence time was increased from 12 to 20 minutes, and the lime slurry feed was added to the effluent hold tank (versus scrubber downcomer) to observe the effect on the liquor sulfate (gypsum) saturation. All other test conditions were the same as for Run 626-1A.

An inspection on August 8 revealed that some sulfite and carbonate scale had formed on the scrubber walls and internals and the mist eliminator vanes, probably because low-sulfur coal had been burned from August 6 to 8. The inlet SO_2 concentration decreased to about 1500 ppm, which resulted in unusually high scrubber outlet liquor pH (6.0 to 6.25). The scale diminished by the end of run. At the end of the run, the mist eliminator was about 2 to 3 percent restricted by scale and solids. The mist eliminator had not been cleaned since the beginning of Run 625-1A, a total of 1075 operating hours.

The spray tower wall below the mist eliminator generally lost scale, and the bottom of the tower showed almost complete loss of old scale. However, the tower walls above the mist eliminator and the outlet duct gained hard scale. These areas were cleaned during the inspection. The venturi section appeared to be cleaner with continued loss of old scale.

For this run, the average calculated sulfate (gypsum) saturation was 65 percent for the scrubber inlet liquor and 115 percent for the scrubber outlet liquor. This is approximately 30 percent lower than for Run 626-1A. Alkali utilization averaged 82 percent. Over an inlet SO_2 concentration range of 1400 to 3500 ppm, SO_2 removal was 69 to 93 percent.

5.2 CONCLUSIONS

Emphasis was placed on the reliable operation of the 316L stainless-steel, three-pass, open-vane chevron mist eliminator during the venturi/spray tower lime reliability testing from June through August 1975.

In earlier lime reliability testing (see Reference 2), a combination of sequential topside and intermittent underside wash used all available makeup water. It had been successful in keeping the mist eliminator free of scale and solids accumulation for 823 hours of operation at 8.0 ft/sec spray tower gas velocity (Run 624-1A).

Further testing of this mist eliminator washing system was conducted at a reduced underside wash rate, increased spray tower gas velocity, and increased solids concentration in the recirculating slurry. The mist eliminator was essentially clean after 1075 hours of operation without cleaning. This included 319 hours at 8.0 ft/sec gas velocity and 8 percent solids recirculated during Run 625-1A, 569 hours at maximum gas velocity of 9.4 ft/sec and 8 percent solids during Run 626-1A, and 187 hours at 9.4 ft/sec and 15 percent solids during Run 627-1A.

The combined makeup water requirement for the topside and bottomside mist eliminator wash during Runs 625-1A, 626-1A, and 627-1A was only about one-half of the available makeup water in closed-liquor-loop operation.

Alkali utilization during these runs averaged 82 to 89 percent, which is typical of the high utilization inherent with lime systems. The relationship between high utilization and reliable mist eliminator operation was not known at the time of these runs. This relationship became apparent during the utilization study (see Section 8).

Section 6

VENTURI/SPRAY TOWER VARIABLE-LOAD TEST RESULTS

A 7-week, variable-load (cycling gas rate) test series with lime (Runs 628-1A and 628-1B) was conducted on the venturi/spray tower system from August to October 1975. These tests were designed to evaluate the ability of the scrubber system to handle the variable gas rate and composition resulting from a daily boiler load cycle. This section presents the performance and analytical data, along with the test run evaluation and conclusions drawn from the tests.

6.1 PERFORMANCE DATA AND TEST EVALUATION

Properties of lime and coal used during these tests can be found in Appendix B. A log of scrubber operating periods is given in Appendix C. Appendix D tabulates analytical data. Variable-load test conditions and results are summarized in Appendix E. Selected operating data are graphically presented in Appendix F. Average scrubber and clarifier overflow liquor compositions and the corresponding calculated percent sulfate (gypsum) saturations are given in Appendix G. An evaluation and discussion of each test is presented below.

6.1.1 Venturi/Spray Tower Run 628-1A

Run 628-1A was started on August 16, 1975, after cleaning of the mist eliminator and the spray tower areas above the mist eliminator, including the outlet duct. The purpose of the run was to test the operability and controllability of the venturi/spray tower system under cycling gas load and a varying inlet gas SO_2 concentration. The gas flow rate for this run (17,000 to 35,000 acfm) was varied so as to follow the actual Boiler No. 10 load (about 60 to 160 MW).

The major test conditions at the start of run were (see Appendix E):

Spray tower gas velocity	4.5 to 9.4 ft/sec
Venturi liquor rate (constant)	600 gpm
Spray tower liquor rate (constant)	1400 gpm
Percent solids recirculated	11
Effluent residence time	12 min
Venturi pressure drop (constant)	9 in. H_2O
Scrubber outlet pH (controlled)	5.0 ± 0.5
Scrubber inlet pH	≤ 8.0

The spray tower liquor rate was increased from 1400 to 1600 gpm on August 26 to improve the SO_2 removal efficiency during periods of high gas rate and high inlet SO_2 concentration. Because of changing gas rate, the liquid-to-gas ratio ranges were 21 to 44 gal/Mcf and 50 to 117 gal/Mcf for the venturi and spray tower, respectively.

The percent solids recirculated was initially specified as 11±3 percent in anticipation of poor control due to the cyclically fluctuating gas rate. However, no difficulty was encountered during the first 10 days of operation, and the percent solids recirculated was lowered to a more desirable 9±2 percent.

The venturi pressure drop was maintained at 9 inches H_2O by varying the adjustable plug position with the gas rate.

The mist eliminator was washed sequentially on the topside and intermittently on the underside using makeup water. The wash rate and cycle were the same as for Runs 626-1A and 627-1A (see Subsection 5.1). The required wash water (2.3 gpm on a continuous basis) was at all times less than the permissible makeup water in closed-liquor-loop operation, even under the worst possible conditions (i.e., low gas rate and high inlet SO_2 concentration).

To prevent sulfite and carbonate scaling during periods of low sulfur coal, the scrubber outlet pH was maintained at 5.0±0.5 and the inlet pH equal to or less than 8.0. Sulfite and carbonate scaling had been experienced during Run 627-1A (see Subsection 5.1.3).

Run 628-1A ended as planned on September 18 after 717 operating hours. Inspections were made after 214, 401, and 510 hours of operation and at the end of the run. The system ran reliably and no significant control problems were encountered during the run.

Inspection at the end of the run showed the mist eliminator condition to be stable, as in the previous inspections, with 2 percent restriction by dust-like solids.

The spray tower walls remained generally unchanged throughout the run, and there was a decrease in old scale in the lower third of the vessel. The bottom of the vessel was clean, with only 5 percent of the surface covered by light scale. Scale on the wall above the mist eliminator varied in coverage and thickness. The top of the vessel was 95 percent covered by light scale, and the vessel outlet held the usual scale collar averaging about 1 inch in thickness. The presence of scale, however, did not hinder the normal operation of the spray tower.

Solids deposits on the venturi section and flooded elbow were stable during the entire run. Only minor scale was seen in the venturi scrubber, and a few minor solid deposits were found at the top of the inlet to the flooded elbow. No significant deposits were seen in the reheater or in the outlet duct.

The average calculated sulfate (gypsum) saturations were 100 and 140 percent for the scrubber inlet and outlet liquors, respectively. Inlet

SO_2 concentration varied from 1500 to 4400 ppm and SO_2 removal ranged from 70 to 98 percent. Alkali utilization averaged 91 percent.

6.1.2 Venturi/Spray Tower Run 628-1B

Run 628-1B was started on September 18, 1975 without system cleaning, and was terminated on October 7 after 426 hours of trouble-free operation. The run was a continuation of Run 628-1A except that the venturi plug position was fixed to observe the effect of cycling gas rate on particulate and SO_2 removal.

The venturi plug position was set to give a maximum pressure drop of 9 inches H_2O at the maximum gas rate of 35,000 acfm. During the run, the gas rate varied between 19,000 and 35,000 acfm (5.1 to 9.4 ft/sec spray tower gas velocity) and the venturi pressure drop varied between 4 and 9 inches H_2O.

As in Run 628-1A, no control problems due to the cycling gas rate were encountered. At the end of the run, the mist eliminator condition was the same (about 2 percent restricted by dust-like solids) as at the end of Run 628-1A.

The spray tower wall below the mist eliminator descaled slightly, but scale increased somewhat in areas above the mist eliminator. This scale did not hinder spray tower operation. Light scale formed on most surfaces of the outlet duct and the reheater.

The inlet gas duct to the venturi was clean, the venturi plug and the inlet cone section had no significant deposits, and the flooded elbow was clean. There was some loss of old scale in the area below the throat.

The stellite diffusers of the slurry spray nozzles (Bete No. ST48FCN) showed no significant wear in approximately 9600 hours of service, although minor pits were scattered along the diffuser spiral. Erosion was observed in the bore of the 316 stainless-steel body of these nozzles.

The average calculated sulfate (gypsum) saturation was 90 percent for the scrubber inlet liquor and 130 percent for the scrubber outlet liquor. These values are each 10 percent lower than those for Run 628-1A. Inlet SO_2 concentration varied from 2000 to 4000 ppm while SO_2 removal ranged from 72 to 96 percent. Alkali utilization averaged 90 percent.

The results of the particulate mass loading tests obtained during Runs 628-1A and 628-1B were questionable because of problems in sample collection, and a direct comparison of the particulate removal efficiencies between the two runs could not be made. A stack-gas characterization program has been planned for the Shawnee Test Facility in the fall of 1976 (see Section 4, Figure 4-1).

6.2 CONCLUSIONS

A 7-week, variable-load test series with lime was conducted on the venturi/spray tower from August to October 1975. A longer period had been scheduled but, because of the excellent results, was not needed. To follow the Boiler No. 10 load, which cycled between 60 and 160 MW, the gas flow rate was varied between 17,000 and 35,000 acfm. Inlet SO_2 concentration ranged from 1500 to 4400 ppm.

During the entire variable-load test sequence, the scrubber system operated well. No problems due to the cycling gas rate and composition were encountered in a total of 1143 hours of operation, including 717 hours at constant 9 inches H_2O venturi pressure drop for Run 628-1A and 426 hours at fixed venturi plug position (4 to 9 inches H_2O pressure drop) for Run 628-1B. The condition of the mist eliminator remained almost unchanged throughout the variable-load tests, with a 2 percent restriction of the total cross-sectional area by dust-like solids at the conclusion of the tests.

Section 7

TCA LIMESTONE RELIABILITY TEST RESULTS

Performance data from reliability testing with limestone on the TCA system from early June through mid-October 1975 are presented in this section. During this period, the major testing effort was concerned with the performance of two different mist elimination configurations. The first consisted of two closed-vane chevron mist eliminators in series; the second was a single open-vane mist eliminator.

Properties of coal and limestone used during the tests can be found in Appendix B. A log of the scrubber operating periods is given in Appendix C. Analytical data are tabulated in Appendix D. Reliability test conditions and results are summarized in Appendix H (see References 1 and 2 for runs made prior to June 1975). Selected operating data for major tests are presented graphically in Appendix I. Average scrubber and clarifier overflow liquor compositions and the corresponding calculated percent sulfate (gypsum) saturations for major runs are given in Appendix J.

7.1 TESTING WITH TWO CHEVRON MIST ELIMINATORS IN SERIES

Prior to the 6-week boiler maintenance outage of Boiler No. 10, which began in April 1975, a washtray (Koch Flexitray) was used in series with a six-pass, closed-vane chevron mist eliminator in the TCA. Although long-term reliability of this mist elimination system had been demonstrated at an 8.6 ft/sec scrubber gas velocity in an 1835-hour test (Run 535-2A), operation of this system at 10 and 12 ft/sec scrubber gas velocity had not been successful (see Reference 2).

Consequently, during the 6-week boiler outage, a new mist elimination system was installed in the TCA for testing at a 12.5 ft/sec scrubber gas velocity. The new mist elimination system, which was supplied by the Air Correction Division of UOP, consisted of two identical three-pass, closed-vane, fiberglass-reinforced plastic (FRP) chevron mist eliminators installed in series (see Figure 3-3), with provision for washing the topside and underside of the lower mist eliminator. Air Correction Division originally requested that a trapout tray be installed below the lower mist eliminator belt. But because of successful operation in the spray tower in lime service of a mist eliminator without trapout tray or washtray, the trapout tray was not installed.

An evaluation and discussion of each test follows (Runs 546-2A through 552-2A). Unless otherwise specified, major operating conditions for these tests were (see Appendix H):

Scrubber gas velocity	12.5 ft/sec
Liquid-to-gas ratio	42 gal/Mcf
Percent solids recirculated	15
Effluent residence time	15 min
Scrubber outlet liquor pH (controlled)	5.4±0.1

The scrubber gas velocity of 12.5 ft/sec corresponds to 8.2 ft/sec superficial velocity in the mist eliminator area. The scrubber outlet slurry pH was controlled at 5.4±0.1 to avoid sulfite scaling on the scrubber internals at high pH and high SO_2 make-per-pass (low liquid-to-gas ratio of 42 gal/Mcf). The scrubber inlet liquor pH was not allowed to exceed 6.0.

During these runs, SO_2 inlet concentration ranged from 2000 to 3500 ppm and SO_2 removal varied from 73 to 89 percent. Alkali utilization ranged from 65 to 83 percent.

7.1.1 TCA Run 546-2A

Run 546-2A was started on June 8, 1975 with clean mist eliminators.

The topside of the lower stage mist eliminator was washed with makeup water at 1.5 gpm/ft^2 (at 23 psig) for 10 minutes at 4-hour intervals.

The underside was washed with the remaining makeup water at 1.5 gpm/ft^2 (at 23 psig) for an average of 7.1 minutes each hour. The upper stage mist eliminator was not washed.

Run 546-2A ended on June 17, 1975, after 207 hours of operation, because of an increasing pressure drop across the mist eliminators. The upper stage mist eliminator was less than 5 percent restricted by solids, but the lower stage was 30 to 35 percent restricted.

The flue gas leaving the lower stage mist eliminator appeared to channel toward the east side of the scrubber, causing heavy solids deposit (up to 200 mils thick) on the east scrubber wall. This was the side toward which the upper blades of the lower stage mist eliminator were oriented.

The average calculated sulfate (gypsum) saturation was 90 percent for both the scrubber inlet and outlet liquors.

7.1.2 TCA Run 547-2A

Run 547-2A was started on June 18 after the mist eliminators had been cleaned.

Both the wash rate and the frequency for the lower stage mist eliminator were increased for this run. The scrubber outlet liquor pH control point was increased from 5.4 to 5.5. Other test conditions were unchanged from Run 546-2A.

The lower stage mist eliminator was washed with makeup water at 2.0 gpm/ft^2 (45 psig) for 20 seconds every 10 minutes on the topside, and for 1 minute every 10 minutes on the underside. Again, the upper stage mist eliminator was not washed.

Because of the apparent flue gas channeling toward the east side of the scrubber between the two mist eliminator stages during the previous run, the east one-third section of the lower stage was horizontally rotated 180 degrees before the test. By this rotation, all the channels between the vanes on the topside of the lower stage mist eliminator were directed towards the center of the scrubber.

The run ended on June 23, 1975, after 112 on-stream hours, because of rapidly increasing pressure drop across the mist eliminators. The restriction of mist eliminators by solids was about 5 percent in the upper stage and 30 to 40 percent in the lower stage. The scrubber walls between the mist eliminators were clean, which suggests that gas channeling due to vane orientation is a factor in solids deposition between mist eliminator stages.

The calculated average sulfate (gypsum) saturation was only 30 percent for the scrubber inlet liquor. However, this may not be a representative value under the conditions tested owing to the relatively short duration of the test.

7.1.3 TCA Runs 548-2A and 549-2A

Runs 548-2A and 549-2A were conducted from June 23 through July 2, 1975. The mist eliminators had been cleaned before the start of Run 548-2A.

The principal objective of the runs was to observe whether the mist eliminators could be kept free of solids deposit with a continuous makeup water underwash for the lower stage. This mode of operation resulted in an open-liquor-loop system. It was planned to resort to continuous underwash with diluted clarified liquor if these runs proved to be successful in keeping the mist eliminators clean.

The lower stage mist eliminator was washed continuously from the underside with makeup water at 26 gpm (0.53 gpm/ft^2 at 8 psig) during Run 548-2A, and at 14 gpm (0.29 gpm/ft^2 at 10 psig) during Run 549-2A. The topside of the lower stage was washed intermittently with makeup water at 2.0 gpm/ft^2 (45 psig) for 30 seconds every 10 minutes during both runs. Other test conditions were unchanged from Run 547-2A.

At the end of Run 548-2A, after 71 hours of operation, the upper stage mist eliminator was 5 percent restricted by solids and the lower stage was entirely clean. However, at the end of Run 549-2A after 112 operating hours (183 hours total), both stages were approximately 5 percent restricted. The solids accumulation appeared to be due to a gap in the lower stage mist eliminator, which resulted when a one-third section of the bottom stage had been inadvertently installed in the wrong alignment.

As expected, because of the open-liquor-loop operation, the average calculated sulfate (gypsum) saturation of the scrubber inlet liquor was only 35 percent for Run 548-2A and 65 percent for Run 549-2A. The latter was higher because less water was used for the lower stage mist eliminator underwash during Run 549-2A.

7.1.4 TCA Runs 550-2A through 552-2A

Runs 550-2A, 551-2A, and 552-2A were conducted from July 2 through July 14, 1975. Their on-stream times were 119, 39, and 86 hours, respectively. The mist eliminators were cleaned before each run. The purpose of these runs was to observe whether the two-stage mist elimination system could be kept free of solids deposit with a continuous underwash for the lower stage using a mixture of makeup water and clarified process liquor.

The wash scheme for the topside of the lower stage mist eliminator during these runs was the same as in Runs 548-2A and 549-2A, i.e., 2.0 gpm/ft^2 for 30 seconds every 10 minutes using makeup water.

During Run 550-2A, the underside of the lower stage mist eliminator was washed continuously with diluted (one-to-one ratio) clarified process liquor at 16 gpm (0.33 gpm/ft^2), using four spray nozzles. Because of frequent plugging problems with these small nozzles, the underwash piping was modified to use a larger single nozzle for the same 16 gpm flow rate during Run 551-2A. The underwash flow rate was increased to 22 gpm (about 8 gpm water and 14 gpm clarified liquor) during Run 552-1A, using four spray nozzles.

Prior to Run 550-2A, the east one-third section of the lower stage mist eliminator, which had been rotated 180 degrees horizontally before Run 547-2A, was inadvertently restored to the original vane orientation.

Despite the short duration of each test, the operations of the mist eliminators were generally not successful during the three runs. The restrictions by solids of the upper stage were 5 to 8 percent, less than 3 percent, and 5 percent for Runs 550-2A, 551-2A, and 552-2A, respectively. For the lower stage, the restrictions were 15 percent, 10 to 15 percent, and 8 to 10 percent, respectively.

Although with continued testing this mist elimination system might have become workable, no further tests were conducted.

7.2 TESTING WITH A SINGLE CHEVRON MIST ELIMINATOR

Because of the success with the spray tower mist eliminator operation with lime (see Sections 5 and 6), a new mist elimination system of similar design (single-stage, 316L stainless-steel, three-pass, open-vane chevron mist eliminator with sequential topside and intermittent bottomside freshwater wash) was installed in the TCA in July 1975 for testing with limestone slurry. An evaluation and discussion of each test (Runs 553-2A through 561-2A) is presented below.

7.2.1 TCA Run 553-2A

TCA limestone Run 553-2A was started on July 19, 1975, to test the operability and reliability of the new single-stage, 316L stainless-steel, three-pass, open-vane chevron mist eliminator.

The major test conditions selected were (see Appendix H):

Scrubber gas velocity	12.5 ft/sec
Liquid-to-gas ratio	50 gal/Mcf
Percent solids recirculated	15
Effluent residence time	15 min
Percent SO_2 removal (controlled)	84

The scrubber gas velocity of 12.5 ft/sec corresponds to a superficial gas velocity of 8.2 ft/sec in the mist eliminator area.

The topside of the mist eliminator was washed sequentially with makeup water, using six spray nozzles on a 4 minutes "on," 76 minutes "off" time cycle, with only one nozzle activated during each "on" cycle. This wash sequence resulted in a total cycle time of 8 hours for the six nozzles. The makeup water flow rate through one nozzle during the "on" cycle was set at 8 gpm (at 13 psig), covering about 14.5 ft^2 to give a specific spray rate of 0.55 gpm/ft^2.

The underside of the mist eliminator was washed intermittently with makeup water, using nine spray nozzles, at 125 gpm (2.5 gpm/ft^2) and 40 psig for 5 minutes each hour.

Run 553-2A ended on July 21, 1975, after only 42 hours of operation, when an inspection revealed that the mist eliminator was 15 percent restricted by solids. This was unexpected since the mist eliminator of similar design in the spray tower had worked reliably at 9.4 ft/sec gas velocity using a similar wash scheme.

The average calculated sulfate (gypsum) saturation of the scrubber inlet liquor was 90 percent. Inlet SO_2 concentration varied from 2300 to 2500 ppm. Alkali utilization averaged 64 percent.

7.2.2 TCA Runs 554-2A through 556-2A

The failure of the mist eliminator operation during TCA Run 553-2A, as compared with the successful operation in the spray tower with lime using a similar mist elimination design and washing scheme, was initially attributed to the differences in the physical design, gas flow distribution, and mist generation pattern within the two scrubbers.*

The scrubber gas velocity was dropped to 9.4 ft/sec (6.1 ft/sec superficial gas velocity in the mist eliminator area) for Runs 554-2A through 556-2A. The liquor rate was maintained at 1200 gpm, giving a liquid-to-gas ratio of 67 gal/Mcf for these runs. The mist eliminator was cleaned before the start of each test.

Run 554-2A was conducted from July 25 to 28, 1975, for 60 operating hours. The washing frequency for the topside of the mist eliminator was doubled (4 minutes "on," 36 minutes "off," at 8 gpm makeup water during the "on" cycle). The frequency for the underside was changed to 6 minutes (at 2.5 gpm/ft^2) every 2 hours. The mist eliminator was 50 percent restricted by solids at the end of the run.

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* It was later discovered that mist eliminator reliability is a strong function of the alkali utilization (see Subsection 8.4).

Because of the failure with the intermittent makeup water mist eliminator underwash, Run 555-2A was tested with a continuous makeup water underwash at 20 gpm (0.4 gpm/ft^2, 25 psig), using a single spray nozzle. The topside wash was unchanged from Run 554-2A. This wash scheme resulted in an open-liquor-loop operation. The run was ended as planned after 63 hours of operation (July 29 to August 1). The mist eliminator was 5 percent restricted by solids at the end of the run. It was thought that a corrosion specimen assembly under the mist eliminator and a Ceilcote panel (for corrosion and erosion testing) under a slurry nozzle might have influenced the mist eliminator underspray pattern and the gas flow distribution. Both assembly and panel were removed for subsequent tests.

Run 556-2A was tested under the same conditions as in Run 555-2A, except that the underside of the mist eliminator was washed continuously with 20 gpm of diluted clarified process liquor (all available makeup water plus clarified liquor). After 89 hours of operation from August 1 to 5, the mist eliminator was essentially clean, with only 2 percent restriction by solids.

The average calculated sulfate (gypsum) saturation of the scrubber inlet liquor for these runs ranged from 55 to 105 percent. Inlet SO_2 concentration ranged from 1500 to 3000 ppm. Alkali utilization varied from 58 to 68 percent.

7.2.3 TCA Runs 557-2A through 561-2A

Runs 557-2A through 561-2A were conducted from August 5 through October 6, 1975. Because of the encouraging result of mist eliminator operation during Run 556-2A, the scrubber gas velocity was increased to 12.5 ft/sec (8.2 ft/sec superficial gas velocity in the mist eliminator area) for Runs 557-2A through 561-2A. As in Run 556-2A, the underside of the mist eliminator was washed continuously during these runs with 20 gpm (0.4 gpm/ft^2) of diluted clarified liquor (all makeup water plus clarified liquor) at 25 psig using a single nozzle. The mist eliminator was cleaned before each of these tests.

Run 557-2A was tested under the same conditions as Run 556-2A except that the scrubber gas velocity was increased to 12.5 ft/sec (liquid-to-gas ratio of 50 gal/Mcf). The wash scheme for the topside of the mist eliminator was unchanged, i.e., sequential wash using six nozzles with 4 minutes "on," 36 minutes "off," at 8 gpm flow rate to each nozzle during the "on" cycle. The run ended after 181 operating hours when an inspection revealed the mist eliminator was 5 percent restricted by solids. The average calculated sulfate (gypsum) saturations were 70 and 80 percent for the scrubber inlet and outlet liquors, respectively.

During Run 558-2A, the time cycle for the mist eliminator sequential topside wash was changed to 6 minutes "on" and 24 minutes "off," with 8 gpm water flow rate to each nozzle during the "on" cycle. This change resulted in a total cycle time of 3 hours for the six nozzles. The mist eliminator was inspected after 229 and 324 hours of operation and again at the end of the run after 398 hours of operation. The mist eliminator restriction increased from 3 percent at 229 hours to 8 to 10 percent at 324 hours, and then to 12 to 14 percent at the end of the run. The solids accumulation occurred mostly on the topside of the northeast section of the mist eliminator vanes, possibly because of uneven distribution of gas flow, and on shadow areas around the vane supports where underside wash liquor did not impinge. The average calculated sulfate (gypsum) saturation was 85 percent for the scrubber inlet liquor and 100 percent for the scrubber outlet liquor.

Owing to the heavier solids deposit on the topside of the northeast mist eliminator section during Run 558-2A, the water flow rate to the northeast and north-center sequential top wash nozzles was increased from 8 to 12 gpm during Run 559-2A. The flow rate to the remaining four nozzles remained at 8 gpm. The sequential top wash cycle was changed to 3 minutes "on" and 7 minutes "off," resulting in a total cycle time of 1 hour for the six nozzles. In addition, the single nozzle for the continuous underwash was moved 6 inches closer to the mist eliminator. Prior to Run 559-2A, plywood plugs were placed flush with the inside wall of the scrubber in the scrubber window ports to reduce gas turbulence. Inspections were made after 88 and 225 hours of operation and at the end of the run at 384 hours of operation. At the time of these inspections, the mist eliminator restrictions were 1, 5, and 7 percent, respectively, and the solids deposit had again formed in shadow areas of the mist eliminator vane supports (three inverted T-beams). The average calculated sulfate (gypsum) saturation for Run 559-2A was 70 percent for the scrubber inlet liquor and 65 percent for the scrubber outlet liquor.

Run 560-2A was tested under the same operating conditions as Run 559-2A. Before the test, to reduce the shadows created by the T-beams, the three inverted T-beams supporting the mist eliminator were removed and the mist eliminator was supported from the topside. At the end of the run, after 142 hours of operation, the mist eliminator was 5 to 7 percent restricted by solids. The solids deposit was heavier in the east half of the mist eliminator. For this run, the average calculated sulfate (gypsum) saturation was 45 percent for both the scrubber inlet and outlet liquors.

Prior to Run 561-2A, all tests with the single-stage mist eliminator had been made with all the upper blades of the mist eliminator oriented toward the east wall of the scrubber. Run 561-2A was tested with the east half of the mist eliminator rotated 180 degrees horizontally, so that the gas flow exiting the mist eliminator was directed toward the center of the scrubber in a more symmetrical flow pattern. The water flow to all six sequential top wash nozzles was adjusted to 8 gpm. These changes resulted in a slightly improved mist eliminator operation. At the end of the run, after 135 on-stream hours, the mist eliminator was 4 to 5 percent restricted by solids. Solids had accumulated mostly in the shadow areas created by the supporting side rails of the mist eliminator. The average calculated sulfate saturation of the scrubber inlet liquor was 55 percent.

During Runs 557-2A through 561-2A, inlet SO_2 concentration ranged from 1500 to 4100 ppm. Average alkali utilization varied from 65 to 74 percent.

7.3 CONCLUSIONS

7.3.1 Testing with Two Chevron Mist Eliminators in Series

At a scrubber gas velocity of 12.5 ft/sec (8.2 ft/sec superficial gas velocity in the mist eliminator area), the two-stage FRP chevron mist elimination system became inoperable within a short time when the lower stage was washed only intermittently with fresh water from both the topside and the underside.

A combination of intermittent fresh water topwash and continuous underwash with diluted clarified liquor for the lower stage significantly reduced solids accumulation in the two-stage mist elimination system. However, long-term reliability of this system was not achieved.

During these tests, average alkali utilization ranged from 65 to 83 percent.

7.3.2 Testing with One Chevron Mist Eliminator

The operation of the single-stage, 316L stainless-steel, three-pass, open-vane chevron mist eliminator was not successful at either 12.5 or 9.4 ft/sec scrubber gas velocity when the mist eliminator was washed sequentially on the topside and intermittently on the underside with fresh water (Runs 553-2A and 554-2A). Alkali utilization during these runs averaged 64 and 63 percent.

A combination of sequential topside wash with fresh water and continuous underside wash with diluted clarified process liquor increased the reliability of this mist elimination system. At 12.5 ft/sec scrubber gas velocity, the mist eliminator restriction by solids appeared to stabilize at less than 10 percent in about 380 hours of operation (Runs 557-2A through 561-2A). Alkali utilization averaged 65 to 74 percent during these runs. Solids accumulation occurred mostly in the shadowed areas of the mist eliminator vanes and support rails not directly impinged upon by the underside wash liquor.

The difficulty in maintaining the mist eliminator free of solids accumulation in the TCA in limestone service was unexpected because of the success in operating a similar mist eliminator in the spray tower in lime service. It was later discovered that high alkali utilization (inherent in a lime system) contributes significantly to the clean operation of a mist eliminator (see Subsection 8.4).

Section 8

LIMESTONE UTILIZATION TESTING IN THE VENTURI/SPRAY TOWER AND TCA SYSTEMS

During the period from October 1975 through mid-February 1976, limestone utilization tests were conducted on both the venturi/spray tower and the TCA systems. These tests were made as a result of a TVA economic study which showed that a potential existed for significantly improving the economics of limestone scrubbing by improving the utilization of the limestone feed (moles SO_2 absorbed/mole Ca added). Improved limestone utilization not only results in a decrease in limestone feed requirements but also a corresponding decrease in waste sludge production.

Tests were conducted primarily to correlate stoichiometric ratio (the reciprocal of alkali utilization) with scrubber inlet liquor pH, effluent hold tank residence time, and hold tank design. For the venturi/spray tower system, a single backmix effluent hold tank was evaluated. For the TCA system, both a single backmix hold tank and three backmix hold tanks in series (to simulate a plug flow reactor) were evaluated. No attempt was made in this report to account for secondary variables such as chloride concentration in the slurry liquor, which ranged from

1500 to 6500 ppm during testing. Models that take such secondary variables into consideration are being developed and will be described in later reports.

For each combination of hold tank residence time and hold tank design, tests were conducted to cover a range of values of scrubber slurry liquor pH. Normally, the systems were run for about 4 to 5 days at a specified level of pH. During testing, the stoichiometric ratios were determined every 4 hours from solids analyses of the scrubber recirculation slurry.

Both the venturi/spray tower system and the TCA system were operated during utilization testing with a single-stage, three-pass, open-vane, 316L stainless-steel mist eliminator with top and bottom wash. Details of the dramatic effect of alkali utilization on mist eliminator operation are discussed in Subsection 8.4.

Properties of raw materials and scrubber operating periods for the utilization runs are given in Appendices B and C, respectively. Data base tables, test result summary tables, graphical operating data, and average liquor composition data for the utilization runs are presented in Appendices D, E, F, and G, respectively, for the venturi/spray tower runs and Appendices D, H, I, and J, respectively, for the TCA runs.

8.1 UTILIZATION TESTING IN THE VENTURI/SPRAY TOWER SYSTEM WITH VARIABLE RESIDENCE TIME

In the venturi/spray tower system, limestone tests were made with a single backmix effluent hold tank to determine the effect of scrubber inlet liquor pH and residence time on stoichiometric ratio. Runs were made at residence times of 20, 12, and 6 minutes.

Major test conditions during this period were:

Spray tower gas velocity	9.4 ft/sec
Venturi liquid-to-gas ratio	21 gal/Mcf
Spray tower liquid-to-gas ratio	50 to 57 gal/Mcf*
Venturi pressure drop	9 in. H_2O
Percent solids recirculated	15

Data showing the relationship between stoichiometric ratio and scrubber inlet liquor pH for the venturi/spray tower system are plotted in Figures 8-1, 8-2, and 8-3 for residence times of 20, 12, and 6 minutes, respectively. The stoichiometric ratio/pH relationship was best defined at 12 minutes residence time. As expected, scatter in the data was greatest at 6 minutes residence time, where pH recovery time was limited and small variations in tank level resulted in significant changes in residence time. At 20 minutes residence time, only a limited number of data were obtained at higher pH values.

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[*] All but two tests were at 50 gal/Mcf.

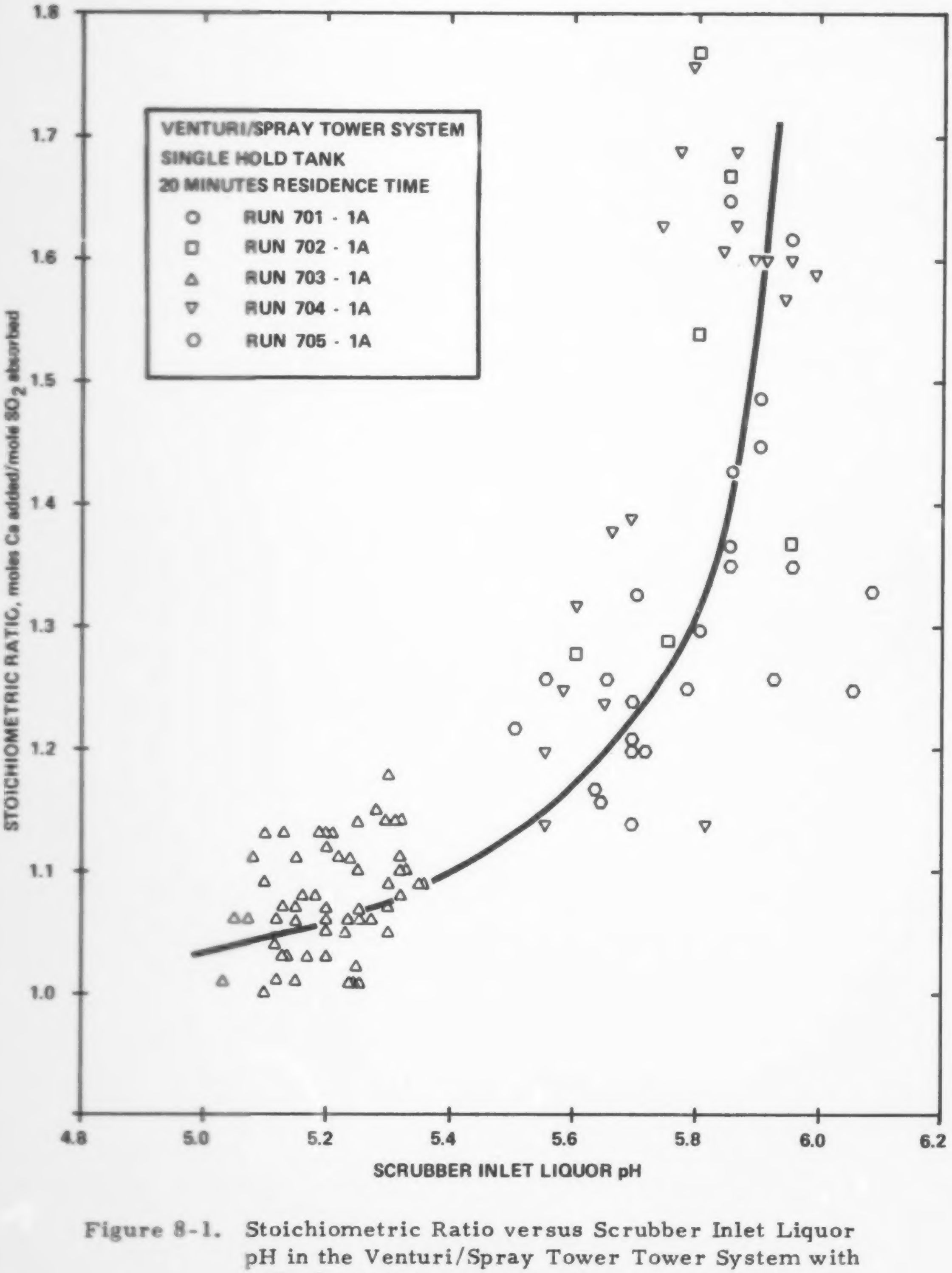

Figure 8-1. Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the Venturi/Spray Tower Tower System with a Single Hold Tank at 20 minutes Residence Time

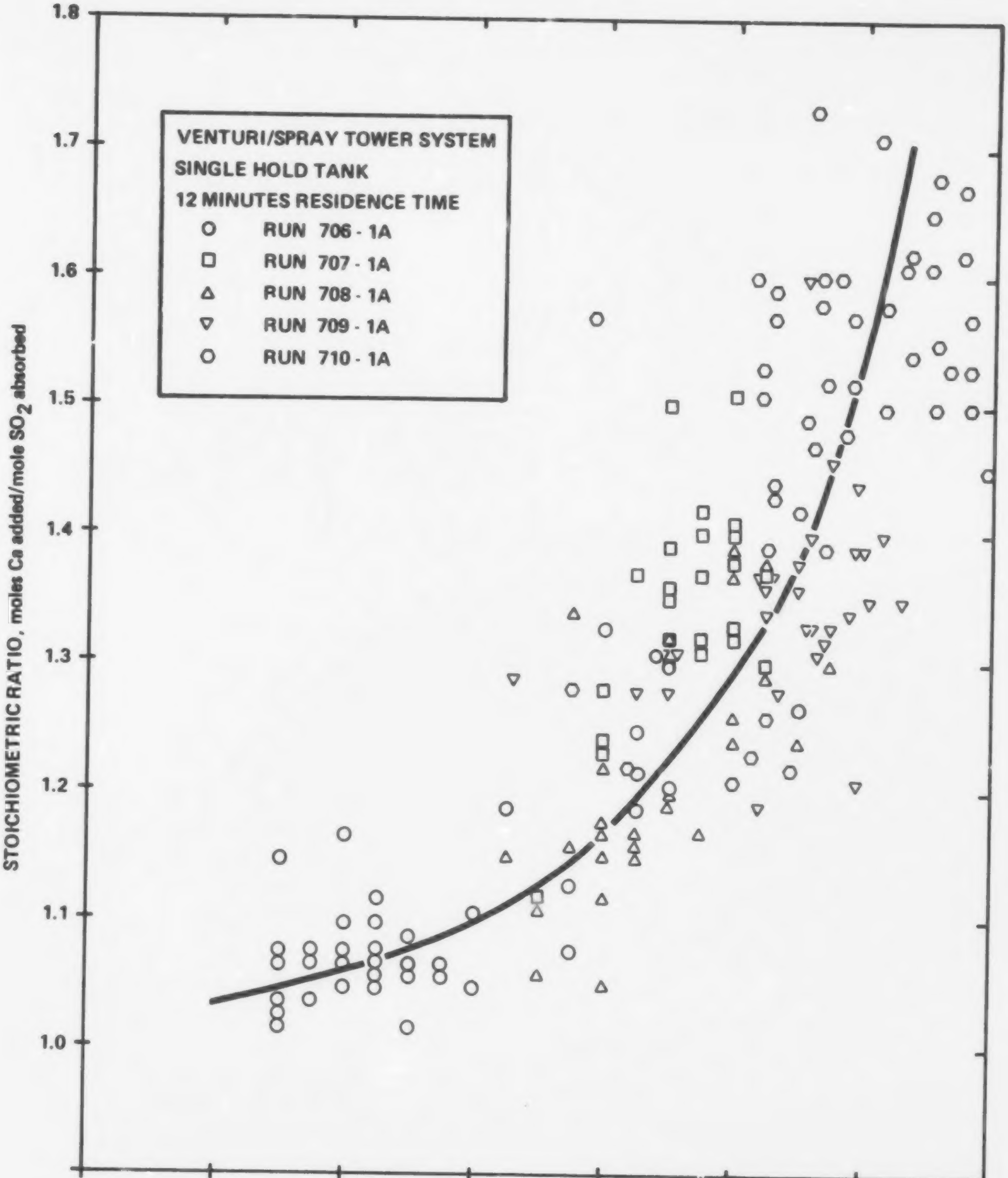

Figure 8-2. Stoichiometric Ratio versus Scrubber Inlet Slurry pH in the Venturi/Spray Tower System with a Single Hold Tank at 12 minutes Residence Time

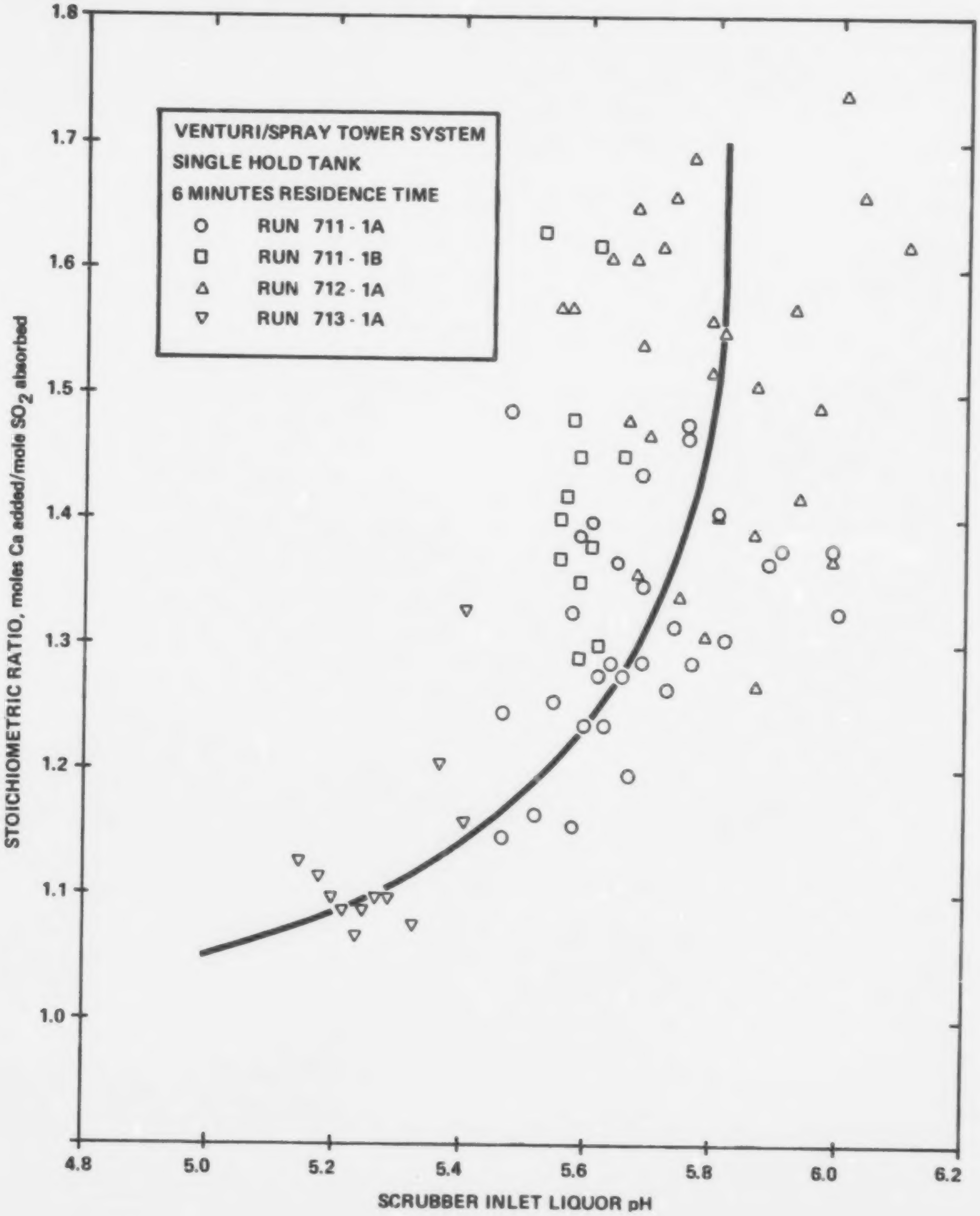

Figure 8-3. Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the Venturi/Spray Tower System with a Single Hold Tank at 6 minutes Residence Time

Sight average curves drawn through the data in Figures 8-1 through 8-3 are compared in Figure 8-4. In Figure 8-4, a tendency for lower stoichiometric ratio at a given pH can be seen as residence time increases. However, above a pH of 5.8, the sight average curve for 20 minutes residence time fell between 6 and 12 minutes. This inconsistency is indicative of the broad scatter of the data.

Figure 8-5 shows the general relationship between SO_2 removal and stoichiometric ratio for an inlet gas SO_2 concentration range between 2500 and 3500 ppm. Data points have been plotted for hold tank residence times of 20, 12, and 6 minutes, and a sight average line through all the data has been drawn. Although a reduction in SO_2 removal at low residence time might be expected, such a decrease could not be discerned within the scatter of the data in Figure 8-5.

Figure 8-6 shows the relationship between SO_2 removal and scrubber inlet liquor pH for an inlet gas SO_2 concentration range from 2500 to 3500 ppm and a 12-minute hold tank residence time. Averages from Figure 8-6 and from similar plots for higher and lower inlet gas SO_2 concentration ranges at 12 minutes. residence time are drawn in Figure 8-7, which shows the effect of inlet gas SO_2 concentration and scrubber inlet slurry pH on SO_2 removal. As expected, an increase in inlet SO_2

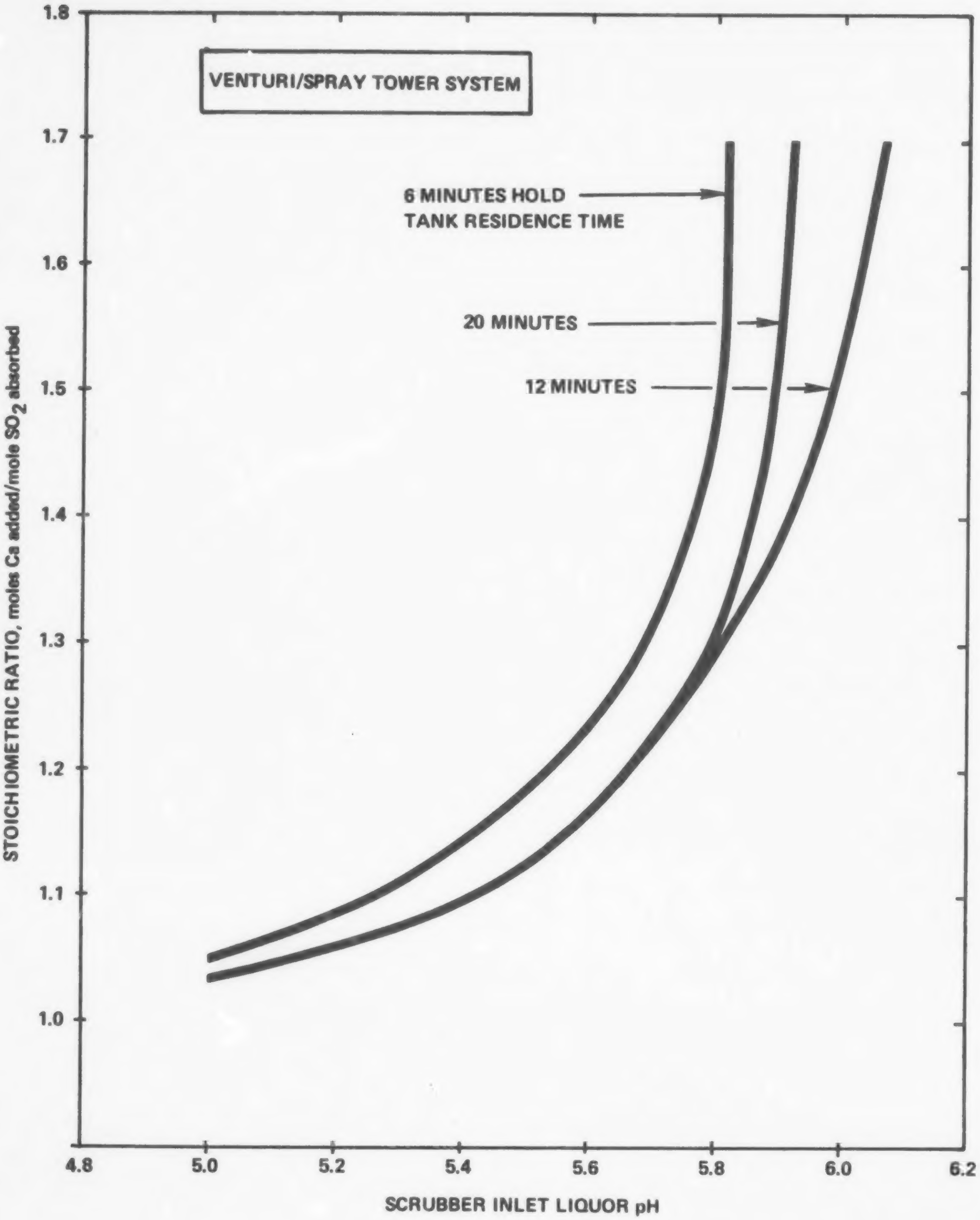

Figure 8-4. The Effect of Effluent Hold Tank Residence Time and Scrubber Inlet Liquor pH on Stoichiometric Ratio in the Venturi/Spray Tower System

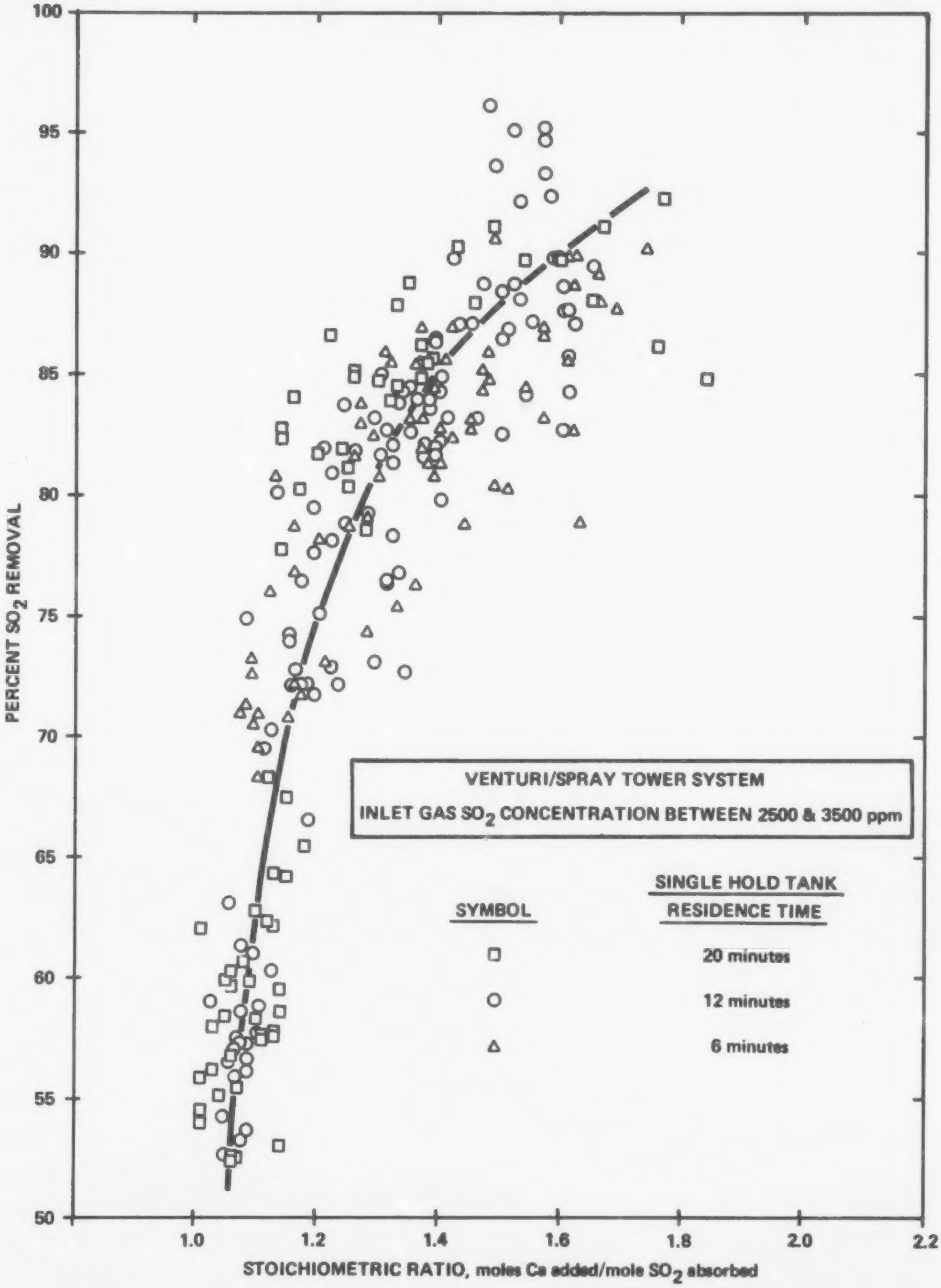

Figure 8-5. The Effect of Stoichiometric Ratio and Effluent Residence Time on Percent SO_2 Removal in the Venturi/Spray Tower with a Single Hold Tank

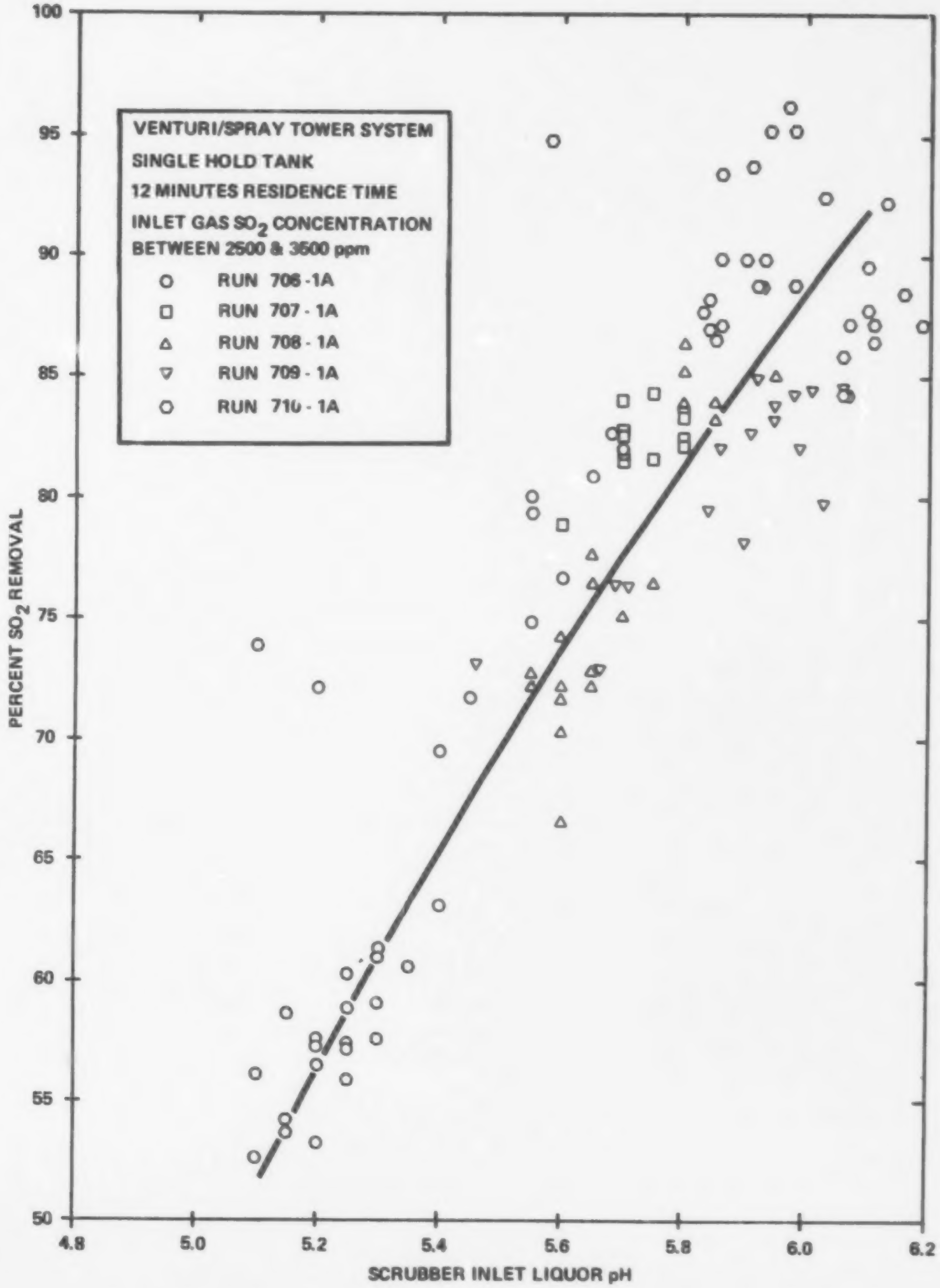

Figure 8-6. The Effect of Scrubber Inlet Liquor pH on Percent SO_2 Removal in the Venturi/Spray Tower System

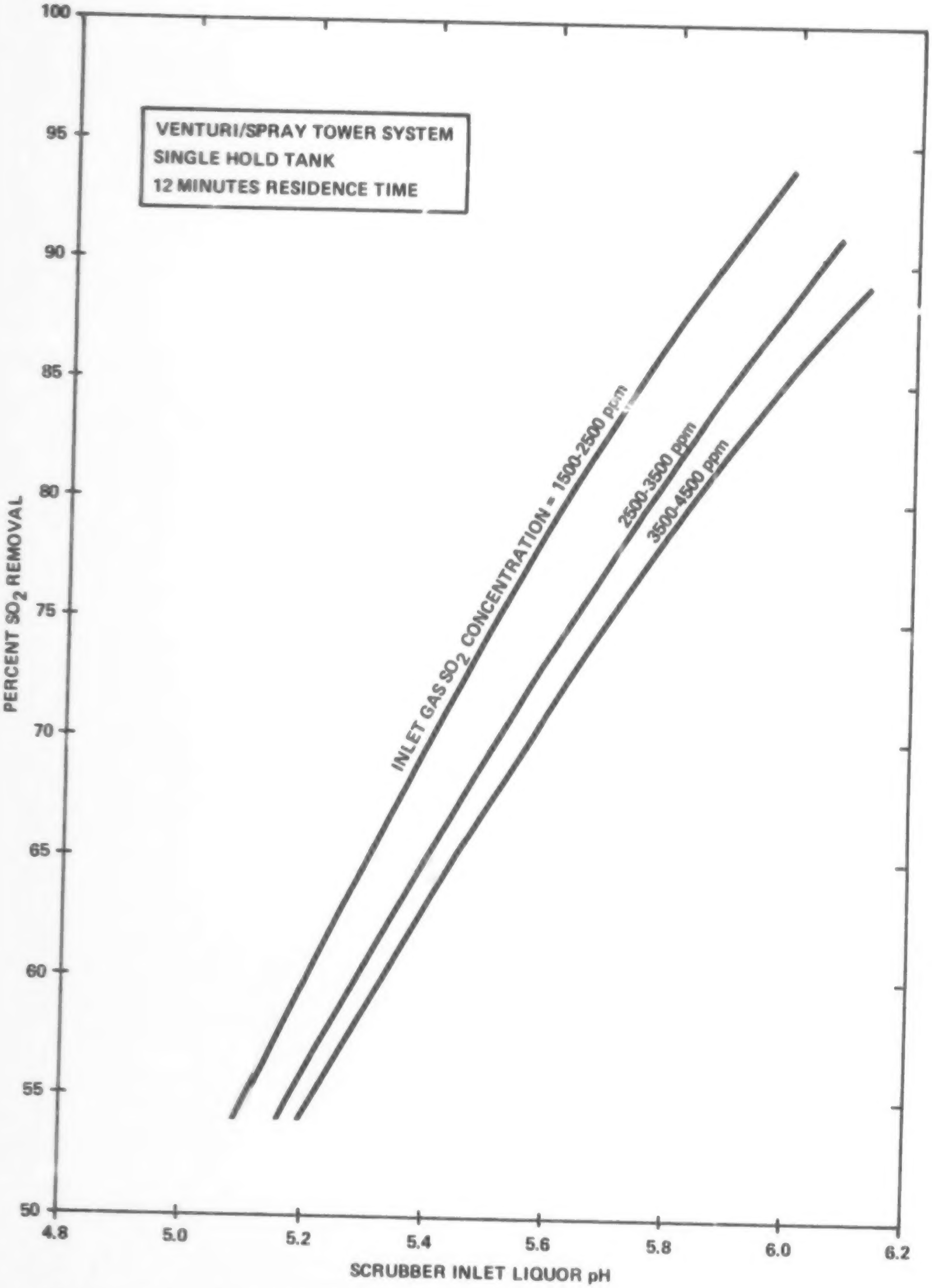

Figure 8-7. The Effect of Scrubber Inlet Liquor pH and Inlet Gas SO_2 Concentration on Percent SO_2 Removal in the Venturi/Spray Tower System

concentration results in a decrease in percentage SO_2 removal at constant inlet pH.*

8.2 UTILIZATION TESTING IN THE TCA SYSTEM WITH THREE HOLD TANKS IN SERIES

Kinetic theory shows that for a continuous system where the reaction order is greater than zero, raw materials are more completely converted in a plug flow reactor than in a backmixed reactor with the same residence time. This concept for improving utilization was successfully tested by Borgwardt (Reference 4) in a 0.1 MW limestone scrubber with both a plug flow reactor and with three stirred tanks in series to approximate plug flow. The concept has now been tested with limestone in the TCA system at the Shawnee Test Facility. Major conditions for these tests were:

TCA superficial gas velocity	12.5 ft/sec
Liquid-to-gas ratio	42 to 50 gal/Mcf
Number of TCA beds	3
Static sphere height per bed**	5 in.
Percent solids recirculated	15

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* See Equation 14-7 in Reference 1.

** Initially, 6-gram, hollow TPR (thermoplastic rubber) spheres were used. These were subsequently replaced with 6.5-gram, nitrile solid foam spheres.

Hold tank configurations tested were:

- Single hold tank at 12 minutes residence time
- Three hold tanks in series at 14.4 minutes total residence time (5.2, 2.6, and 6.6 minutes, respectively)
- Three hold tanks in series at 10.8 minutes total residence time (4.6, 2.3, and 3.9 minutes, respectively)

The total residence times for the runs with three hold tanks in series were intended to be 12 and 9 minutes, but because of a flow meter error (1000 gpm actual circulating slurry flow rate at a indicated meter reading of 1200 gpm), the total residence times were actually 14.4 and 10.8 minutes.

Results of the utilization testing for these three configurations are plotted as stoichiometric ratio versus scrubber inlet liquor pH in Figures 8-8, 8-9, and 8-10, respectively. Sight drawn averages from Figures 8-8 through 8-10 are compared in Figure 8-11. For the runs with three tanks in series, there was no significant difference between 10.8 minutes and 14.4 minutes residence time. However, there was a distinct difference between operation with a single tank and with three tanks in series at pH values greater than about 5.0. For example, at a scrubber inlet liquor pH of 5.6, the stoichiometric ratio averaged 1.19 with a single hold tank as compared with 1.11 with three tanks

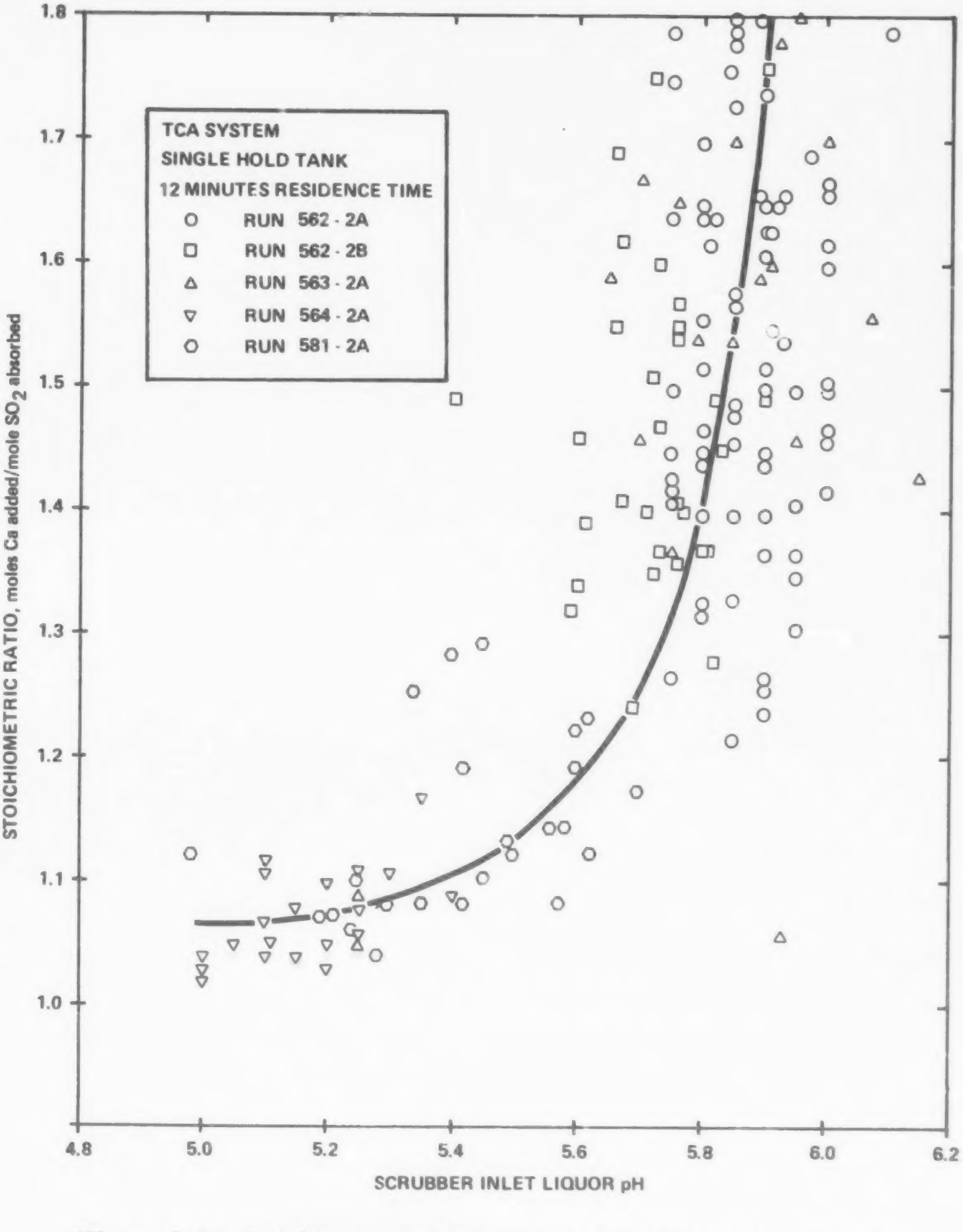

Figure 8-8. Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the TCA System with a Single Hold Tank at 12 minutes Residence Time

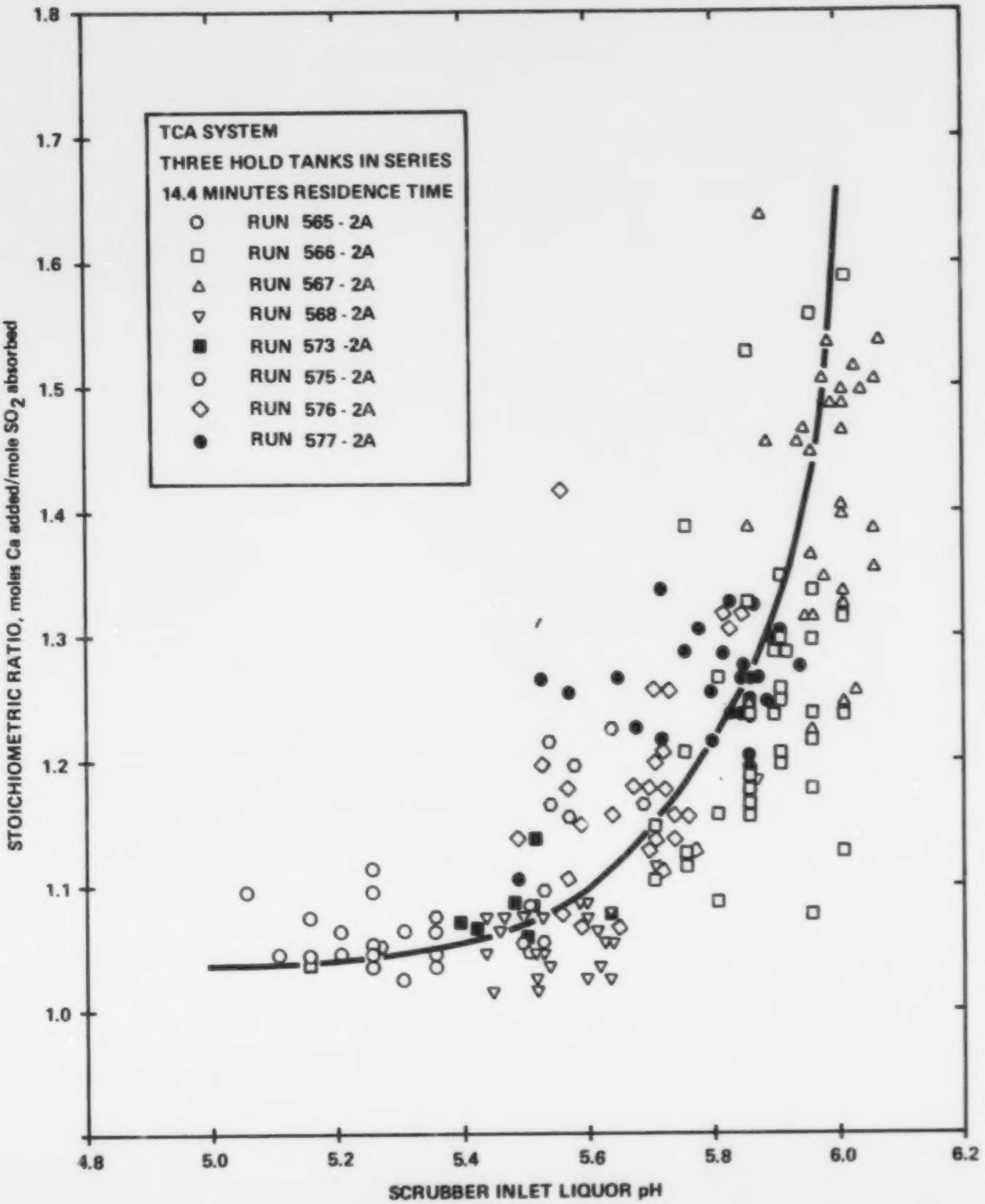

Figure 8-9. Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the TCA System with Three Hold Tanks in Series at 14.4 minutes Residence Time

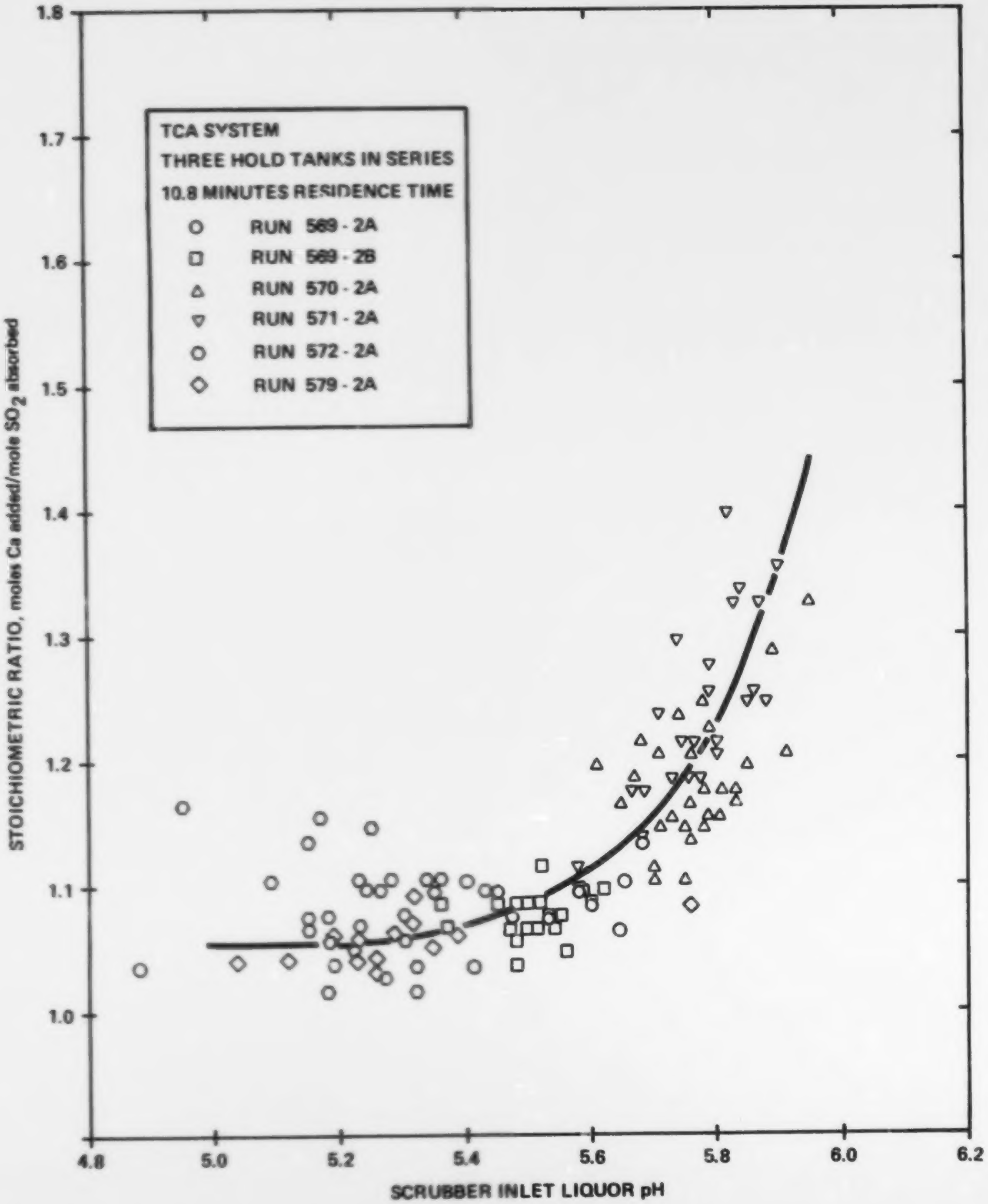

Figure 8-10. Stoichiometric Ratio versus Scrubber Inlet Liquor pH in the TCA System with Three Hold Tanks in Series at 10.8 minutes Residence Time

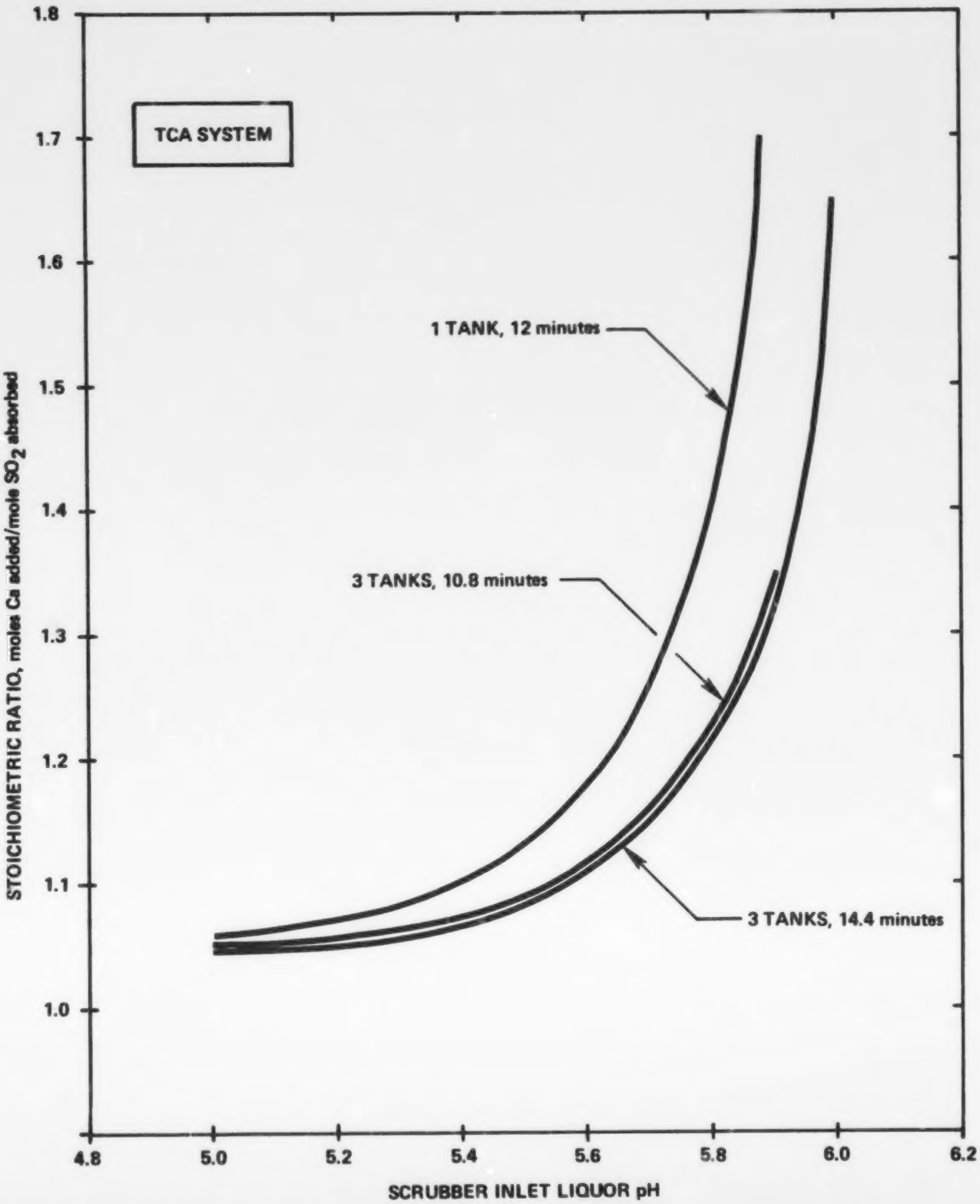

Figure 8-11. The Effect of Scrubber Inlet Liquor pH and Hold Tank Configuration on Stoichiometric Ratio in the TCA System

in series. The latter is a 7 percent improvement in limestone utilization. At higher pH, the improvement was greater; e.g., at pH 5.8, the improvement in utilization was 14 percent.

The improvement in utilization with three tanks in series can also be seen in Figure 8-12, where SO_2 removal is plotted against stoichiometric ratio for an inlet gas SO_2 concentration range of 2500 to 3500 ppm. At 85 percent SO_2 removal, the stoichiometric ratio with three tanks in series averaged about 15 percent lower than with a single tank. This comparison is valid even though the residence times and the liquid-to-gas ratios are different for the data shown. Residence time does not significantly affect stoichiometric ratio for three tanks in series (see Figure 8-11). Increase in liquid-to-gas ratio increases SO_2 removal. Thus, the improvement of utilization with three tanks would have been even greater than shown in Figure 8-12 if the data for three tanks in series had been taken at the same liquid-to-gas ratio as for the single tank data.

Data for three tanks in series at 10.8 minutes residence time were not included in Figure 8-12 because the TPR spheres in the TCA were replaced with nitrile solid foam spheres during the 10.8 minute testing. Unfortunately, the effect of 10.8 minutes residence time on SO_2 removal could not be separated from the effect of the new bed of spheres on SO_2 removal.

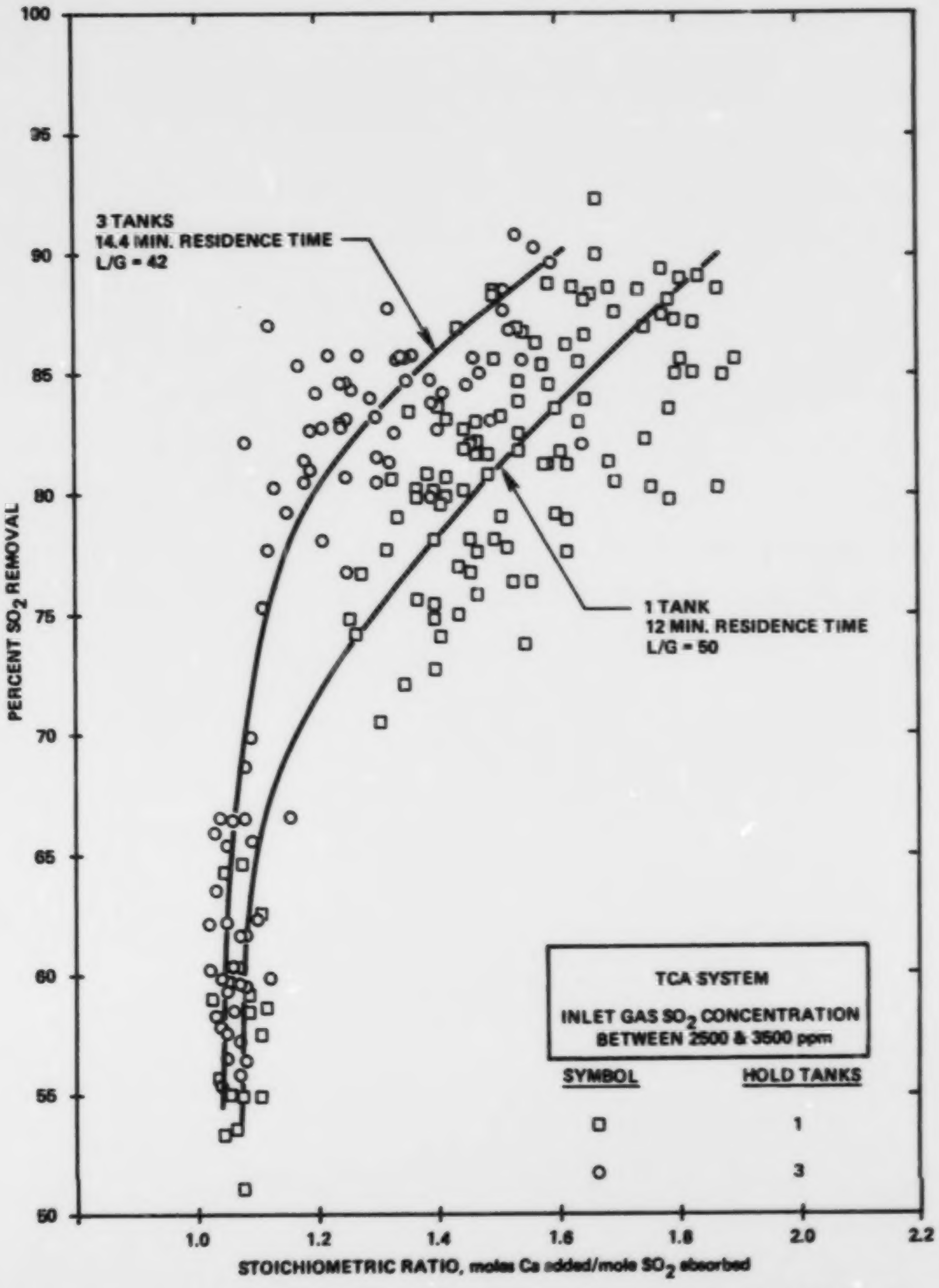

Figure 8-12. The Effect of Stoichiometric Ratio and Hold Tank Configuration on Percent SO_2 Removal in the TCA System

8.3 UTILIZATION DATA FROM DEPLETION RUNS

During January and early February 1976, several limestone depletion runs* were conducted on both the venturi/spray tower and TCA systems to determine if valid utilization data could be produced by this method. The results of these tests are plotted in Figures 8-13, 8-14, and 8-15, along with the corresponding sight average line from the normal utilization tests. Most of the data fell within the scatter band of the normal utilization test data, but did not define the same average line. In general, the depletion data defined a lower utilization than indicated by longer term runs. Since the methods did not give the same result, data from depletion runs were not included in the plots of Subsections 8.1 and 8.2.

8.4 MIST ELIMINATOR OPERABILITY DURING LIMESTONE UTILIZATION TESTING

Tables 8-1 and 8-2 summarize the results of mist eliminator operability during the limestone utilization testing. These tables list the average scrubber inlet liquor pH, average limestone utilization and stoichiometric ratio, mist eliminator wash scheme, and percent of the mist eliminator passage restricted by solids deposit at the end of each run. Mist eliminator restriction was estimated visually by

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* Limestone depletion runs were conducted without limestone addition during SO_2 absorption. The scrubber inlet liquor pH was allowed to drop from about 5.9 to 4.8.

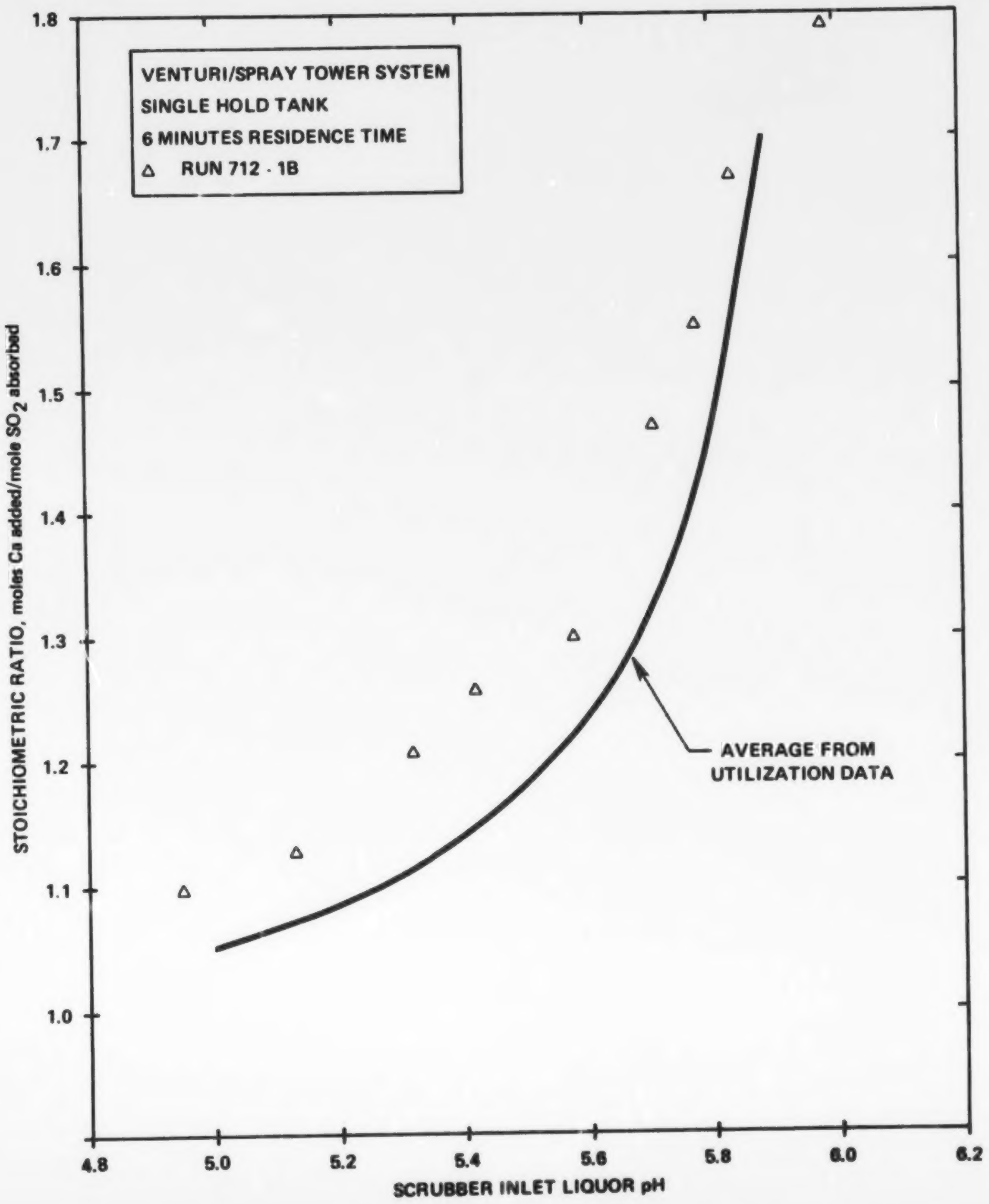

Figure 8-13. Stoichiometric Ratio versus Scrubber Inlet Liquor pH for Depletion Test at 6 minutes Residence Time in the Venturi/Spray Tower System

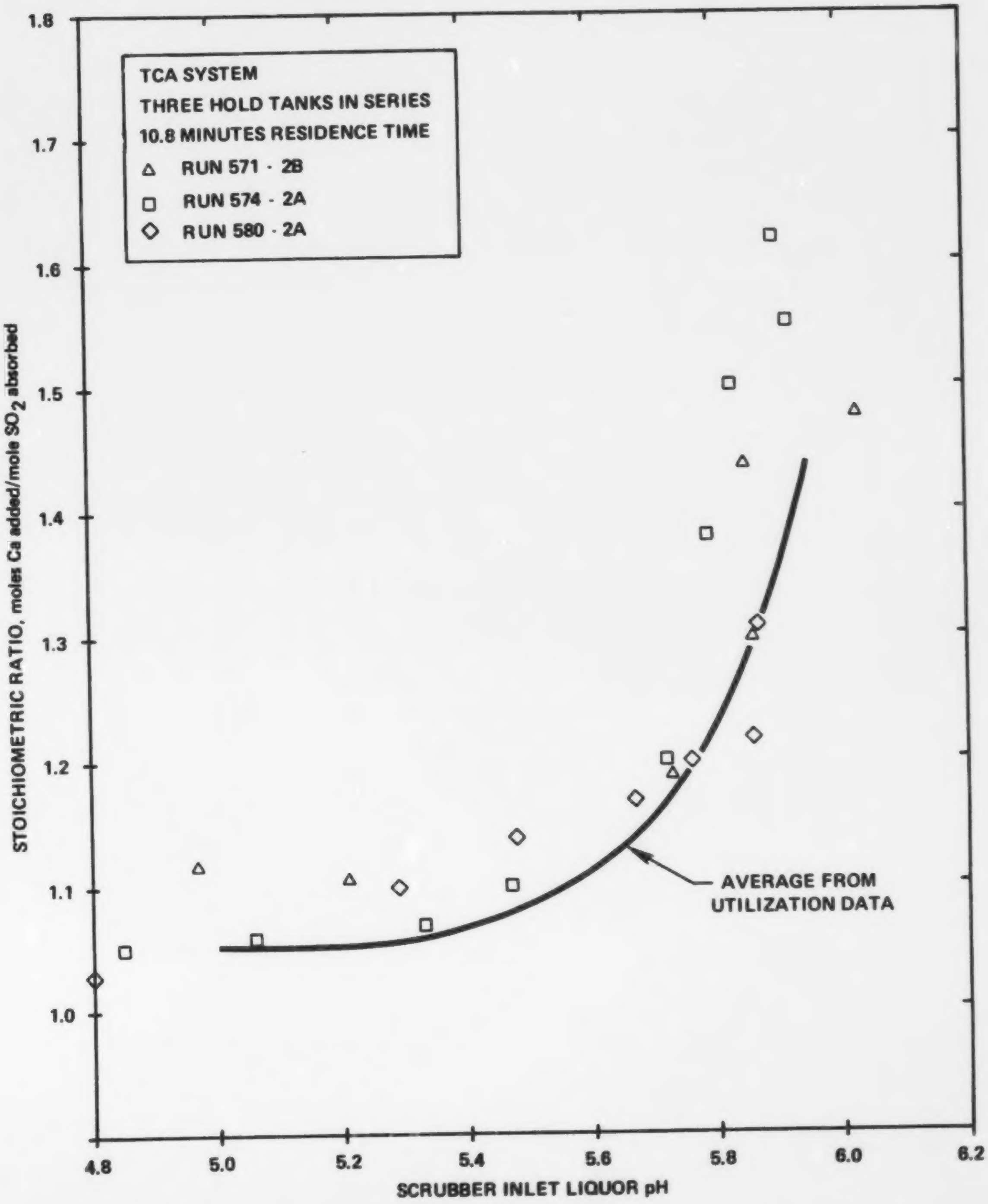

Figure 8-14. Stoichiometric Ratio versus Scrubber Inlet Liquor pH for Depletion Tests in the TCA System with Three Hold Tanks in Series at 10.8 minutes Residence Time

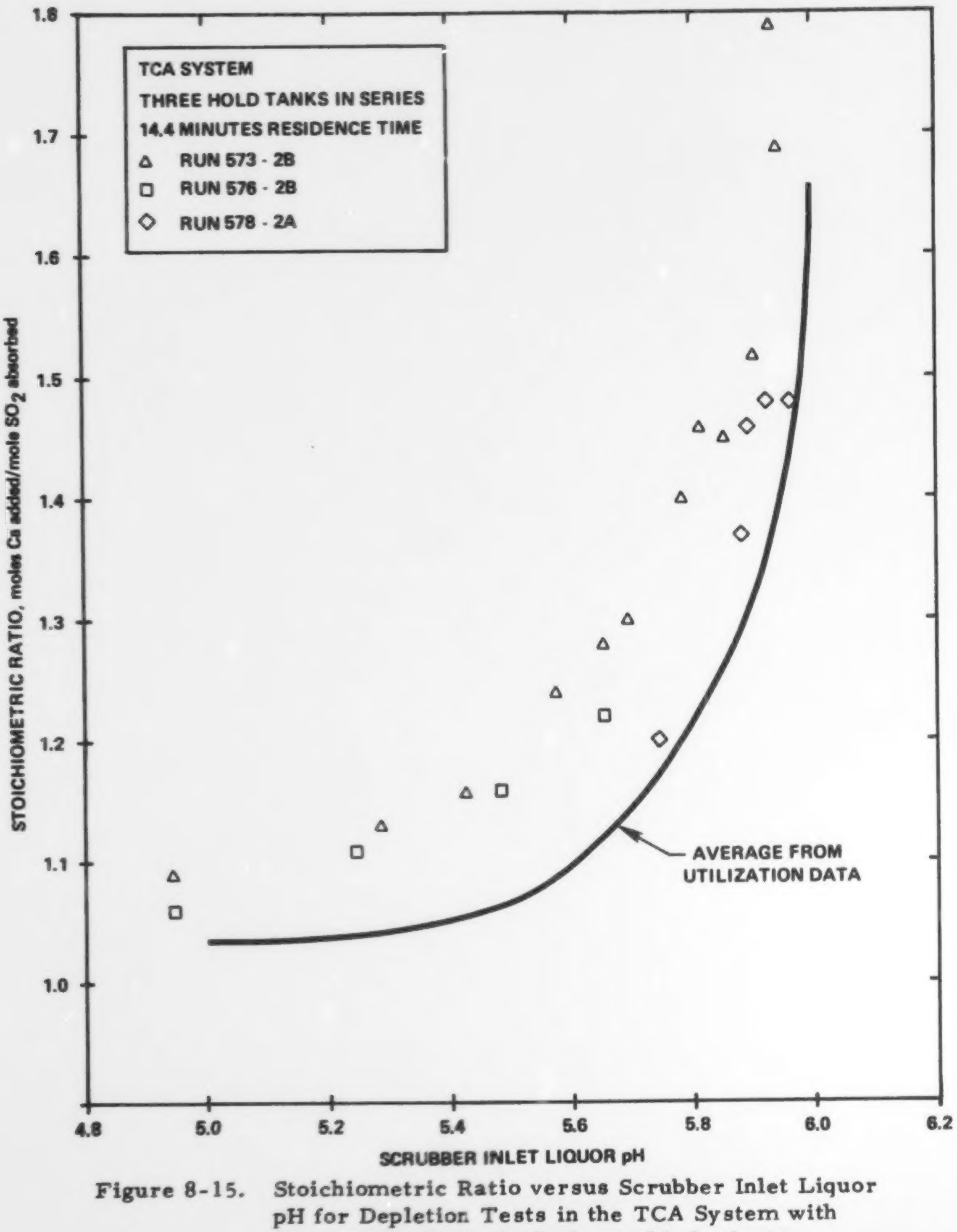

Figure 8-15. Stoichiometric Ratio versus Scrubber Inlet Liquor pH for Depletion Tests in the TCA System with Three Hold Tanks in Series at 14.4 minutes Residence Time

Table 8-1

SUMMARY OF VENTURI/SPRAY TOWER LIMESTONE UTILIZATION AND MIST ELIMINATOR TESTS

Run No.	Single Tank Res. Time, min.	Avg. Scrubber Inlet Liquor pH	Avg. Stoich. Ratio	Avg. Percent Limestone Utilization	Avg. Percent SO_2 Removal[g]	Mist Eliminator Wash Scheme		Run Hours	Hours Since Cleaning Mist Eliminator	Percent Mist Eliminator Restriction
						Top	Bottom			
701-1A	20	5.90	1.45	69	88	Intermittent[a]	Intermittent[b]	73	73	50-60
702-1A	20	5.80	1.45	69	87	↓	↓	60	60	45-50
703-1A	20	5.20	1.07	93	58	↓	↓	319	319	1
704-1A	20	5.75	1.45	69	86	↓	↓	66	385	45-50
705-1A	20	5.65	1.25	80	84	↓	↓	136	136	17-20
706-1A	12	5.30	1.06	94	58	↓	↓	180	180	1
707-1A	12	5.75	1.30	77	83	Intermittent[c]	Intermittent[d]	118	298	10-15
708-1A	12	5.65	1.20	83	77	↓	Intermittent[d]	138	436	15-20
709-1A	12	5.85	1.35	74	83	↓	Continuous[e]	134	134	<1
710-1A	12	6.00	1.50	67	91	↓	↓	234	368	5-7
711-1A	6	5.70	1.30	77	81	↓	↓	144	512	-
711-1B	6	5.55	1.40	71	82	↓	↓	71	583	5-7
712-1A	6	5.80	1.50	67	87	↓	↓	119	702	10-15
712-1B	6	Depletion[f]	-	-	-	↓	↓	18	720	-
713-1A	6	5.25	1.10	91	69	↓	↓	52	772	10
714-1A[h]	6	5.55	1.25	80	90	Intermittent[a]	Intermittent[b]	157	157	2
715-1A	20	5.30	1.43	70	25[i]	↓	↓	23	180	-
716-1A	20	4.80	1.98	51	13[i]	↓	↓	18	198	-
717-1A	6	5.45	1.18	85	88	↓	↓	181	379	8

Note: All runs made with a 316 stainless steel, 3-pass, open-vane, chevron mist eliminator. Run conditions: 15 wt % solids in recirculated slurry, 9.4 ft/sec spray tower superficial gas velocity, 21 gal/mcf liquid-to-gas ratio in venturi, 50-57 gal/mcf liquid-to-gas ratio in spray tower (except Runs 715-1A and 716-1A had no slurry flow to spray tower).

(a) Intermittent, sequential top wash with makeup water at 0.53 gpm/sqft for 4 min/8 hr/section.
(b) Intermittent, full face bottom wash with makeup water at 1.5 gpm/sqft for 6 min/4 hr.
(c) Intermittent, sequential top wash with makeup water at 0.53 gpm/sqft for 3 min/hr/section.
(d) Intermittent, full face bottom wash with makeup water at 1.5 gpm/sqft for 4 min/hr.
(e) Continuous, full face bottom wash with diluted clarified liquor at 0.4 gpm/sqft.
(f) A limestone depletion run is conducted without limestone addition during SO_2 absorption. The scrubber inlet liquor pH is allowed to drop from about 5.9 to 4.8.
(g) SO_2 removals are for 2500 to 3500 ppm inlet gas SO_2 concentration.
(h) A liquor Mg^{++} ion concentration of 5000 ppm was maintained during Runs 714-1A through 717-1A by addition of MgO in the effluent hold tank. The limestone stoichiometric ratios and utilizations for these runs have been corrected to account for sulfur in liquid phase, which is normally negligible when no MgO is added.
(i) Venturi only operation (no slurry flow to spray tower).

Table 8-2

SUMMARY OF TCA LIMESTONE UTILIZATION AND MIST ELIMINATOR TESTS

Run No.	No. Tanks	Total Res. Time, min[f]	Avg. Scrubber Inlet pH	Avg. Stoich. Ratio	Avg. Percent Limestone Utilization	Avg. Percent SO_2 Removal[e]	Mist Eliminator Wash Scheme		Run Hours	Hours Since Cleaning Mist Eliminator	Percent Mist Eliminator Restriction
							Top	Bottom			
562-2A	1	12	5.90	1.6	63	83	Intermittent[a]	Continuous[b]	495	155	2
										332	5-7
										495	7-9
562-2B	1	12	5.65	1.4	71	81			134	629	7
563-2A	1	12	5.85	1.7	59	86			182	811	7
564-2A	1	12	5.15	1.06	94	58			113	924	3
565-2A	3	14.4	5.25	1.05	95	58			109	109	0
566-2A	3	14.4	5.85	1.25	80	83			166	275	0
567-2A	3	14.4	5.95	1.4	71	84			138	413	2
568-2A	3	14.4	5.55	1.06	94	63		Intermittent[c]	162	575	1
569-2A	3	10.8	5.50	1.08	93	69			66	641	<1
569-2B	3	10.8	5.50	1.08	93	64			97	738	<1
570-2A	3	10.8	5.80	1.18	85	72			144	882	<1
571-2A	3	10.8	5.80	1.25	80	73			96	978	<1
571-2B	3	10.8	Depletion[d]	-	-	-			11	989	-
572-2A	3	10.8	5.25	1.09	92	57			154	1143	-
573-2A	3	14.4	5.55	1.08	93	66	No wash		45	1188	<1
573-2B	3	14.4	Depletion	-	-	-			28	1216	-
574-2A	3	10.8	Depletion	-	-	-			12	1228	40
575-2A	3	14.4	5.55	1.15	87	69			47	47	-
576-2A	3	14.4	5.70	1.17	85	73			112	159	-
576-2B	3	14.4	Depletion	-	-	-			3	162	3
577-2A	3	14.4	5.80	1.25	80	83	Intermittent[a]		159	159	20
578-2A	3	14.4	Depletion	-	-	-			9	168	-
579-2A	3	10.8	5.25	1.05	95	61			62	230	-
580-2A	3	10.8	Depletion	-	-	-			12	242	10
581-2A	1	14.4	5.45	1.15	87	80			164	406	-
582-2A	1	14.4	Depletion	-	-	-			18	424	2

Note: All runs made with a 316 stainless steel, 3-pass, open-vane, chevron mist eliminator. Run conditions: 15 wt % solids in recirculated slurry, 12.5 ft/sec TCA superficial gas velocity, 42-50 gal/mcf liquid-to-gas ratio. TCA configuration: 3 beds with 5 inches per bed of 6-gram TPR spheres for Runs 562-2A through 569-2A and 6.5-gram nitrile foam spheres for Runs 569-2B through 582-2A.

(a) Intermittent, sequential top wash with makeup water at 0.55-0.83 gpm/sq ft for 3 min/hr/section.
(b) Continuous, full face bottom wash with duluted clarified liquor at 0.4 gpm/sq ft.
(c) Intermittent, full face bottom wash with makeup water at 1.5 gpm/sq ft for 4 min/hr.
(d) A limestone depletion run is conducted without limestone addition during SO_2 absorption. The scrubber inlet liquor pH is allowed to drop from about 5.9 to 4.8.
(e) SO_2 removals are for 2500 to 3500 ppm inlet gas SO_2 concentration.
(f) For runs 565-2A through 582-2A, liquor rate was 1000 gpm instead of the required 1200 gpm due to a flowmeter error.

onsite personnel during inspections. All of the available makeup water was used for tests with continuous mist eliminator bottom wash, while only about one-half of the available makeup water was used for tests with intermittent bottom wash.

During venturi/spray tower limestone Runs 701-1A and 702-1A (see Table 8-1) with intermittent topside and bottomside makeup water wash, the mist eliminator was heavily restricted by soft solids within 2 to 3 days. This was unexpected because earlier operation with lime slurry under nearly identical operating conditions was successful (see Run 627-1A, Section 5). The limestone utilization for Runs 701-1A and 702-1A was only 68 percent, as compared with 90 percent normally obtained with lime operation. Subsequently, during Run 703-1A, the limestone utilization was increased to 93 percent by dropping the average scrubber inlet liquor pH to 5.2. The mist eliminator was found to be essentially clean (1 percent restricted) after 319 operating hours with intermittent underside and topside raw water wash. The average SO_2 removal for Run 703-1A was only 58 percent, as compared with 87 percent for the previous tests.

Subsequent venturi/spray tower Runs 704-1A through 708-1A confirmed the observation that reliable mist elimination operation could be obtained only at high alkali utilization (greater than about 85 percent), with intermittent underside and topside wash using makeup water. Runs 709-1A through 711-1B also showed that for utilization less than about

85 percent, continuous bottomside wash with diluted clarified liquor could reduce or limit the amount of soft solids deposition on the mist eliminator vanes.

Testing with the TCA system similarly confirmed the strong effect of limestone utilization on mist eliminator reliability. Runs 562-2A, 562-2B, and 563-2A (see Table 8-2) were conducted at average scrubber inlet liquor pH values of 5.7 to 5.9, with limestone utilizations from 59 to 71 percent. The mist eliminator was washed intermittently with fresh water on the topside, and continuously with diluted clarified liquor on the bottomside. The mist eliminator restriction increased to 7 to 9 percent during the first 500 hours of operation and appeared to level out at 7 percent restriction after 811 hours at the end of Run 563-2A. Following these tests, the scrubber inlet liquor pH was dropped to 5.2 (Run 564-2A) and the operation continued for an additional 113 hours. At the end of Run 564-2A, the mist eliminator restriction decreased to 3 percent from the 7 percent at the start of the run. The limestone utilization during Run 564-2A averaged 94 percent. This decrease in mist eliminator restriction indicates that in some cases an already fouled mist eliminator can be cleaned by increasing the alkali utilization.

As was discussed in Subsections 8.1 and 8.2, operation at reduced scrubber inlet liquor pH to achieve high utilization causes a reduction in SO_2 removal efficiency. SO_2 removal efficiency at high utilization can be increased in a number of ways, including increasing the slurry flow to the absorber, increasing the TCA packing height and gas phase pressure drop, or adding MgO to the scrubber slurry. Furthermore, SO_2 removal efficiency can be increased while maintaining high limestone utilization by operating with three hold tanks in series.

Venturi/spray tower limestone Runs 714-1A through 717-1A (see Table E-2 and Figures F-17 through F-19) were conducted to obtain scrubber liquor pH and SO_2 removal data at a specified limestone stoichiometry and a steady-state liquor Mg^{++} concentration of 5000 ppm. Table 8-1 shows that the mist eliminator was only 2 percent restricted after 157 hours of operation during Run 714-1A, at an average limestone utilization of 80 percent and with an intermittent topside and underside freshwater wash. During Runs 715-1A and 716-1A, the slurry flow to the spray tower was turned off with only the venturi in operation. The scrubber inlet liquor pH dropped steadily during these two runs, even at an increased limestone addition rate, resulting in SO_2 gas evolution from the effluent hold tank and centrifuge. The mist eliminator restriction increased to 8 percent at the end of Run 717-1A after a total of 379 operating hours. This increase was probably due to the low limestone utilization during Runs 715-1A and 716-1A.

TCA Runs 565-2A through 580-2A were operated with three hold tanks in series (see Table 8-2). As with the venturi/spray tower system, continuous bottomside wash with diluted clarified liquor and intermittent topside wash with makeup water limited the amount of soft solids deposition at low utilization (Run 567-2A). Also, the mist eliminator was kept completely free of solids with continuous bottomside wash at high utilization (Runs 565-2A and 566-2A). As expected, with intermittent bottomside and topside wash at high alkali utilization (Runs 568-2A through 573-2A), the chevron mist eliminator remained nearly free of solids. After a total of 1188 operating hours with continuous and intermittent bottomside wash and intermittent topside wash, the chevron mist eliminator in the TCA was less than 1 percent restricted with soft solids (see Run 573-2A in Table 8-2).

A further example of a mist eliminator that had become less restricted during operation at high utilization can be seen in Runs 577-2A through 582-2A. At the conclusion of Run 577-2A (run at 80 percent limestone utilization), the mist eliminator was 20 percent restricted by soft solids, and after an additional 226 hours of operation at 97 and 87 percent utilization (Runs 579-2A and 581-2A), the mist eliminator restriction decreased to 2 percent.

8.5 CONCLUSIONS

- Limestone utilization in the venturi/spray tower and TCA systems normally varied from about 60 percent at a scrubber inlet liquor pH of 6.0 to about 95 percent at a scrubber inlet liquor pH of 5.2. Operation at reduced scrubber inlet liquor pH, however, caused a reduction in SO_2 removal efficiency when other test conditions were held constant.

- For the venturi/spray tower system with a single effluent hold tank, limestone utilization tended to be higher at 12 to 20 minutes residence time than at 6 minutes residence time.

- For the TCA system within the range of total effluent residence times tested (10.8 to 14.4 minutes) and at scrubber inlet liquor pH values greater than about 5.0, higher limestone utilization can be achieved with three hold tanks in series than with a single hold tank.

- The reliability of the mist elimination system is a strong function of alkali utilization.

- For high alkali utilization (greater than about 85 percent), the mist eliminator can be kept free of solids deposits by an intermittent makeup water top wash combined with either intermittent bottom wash with makeup water or continuous bottom wash with diluted clarified liquor. Intermittent wash may be required in closed-liquor-loop operation owing to restrictions in the allowable makeup water to the scrubber system.

- For alkali utilization less than about 85 percent, intermittent top and bottomside wash with makeup water does not limit solids accumulation. However, for these conditions, a continuous bottom wash with diluted clarified liquor used in combination with an intermittent topside wash with makeup water can limit soft solids buildup to a stable condition of less than 10 percent restriction within the mist eliminator.

- Operation for a period of time at high alkali utilization (greater than about 90 percent) may, in certain instances, clean up an already fouled mist eliminator.

Section 9

LABORATORY QUALITY ASSURANCE PROGRAM

The Shawnee Advanced Test Program has put an increasingly heavy analytical load on the test facility chemical laboratory. At the same time, the analytical results have never been more important for the control of system parameters and for the development of advanced theoretical models by which lime/limestone SO_2 scrubbing systems may be described.

To achieve the objectives of the Advanced Test Program, it was necessary to perform some of the analytical procedures more rapidly and with greater precision and accuracy than was the case in previous long-term reliability tests. Therefore, a quality assurance program was initiated at the test facility to identify procedures that did not satisfy the needs of the Advanced Test Program. The goals of the laboratory quality assurance program included the following:

- To establish the precision and accuracy of the analytical methods used at Shawnee
- To provide continuous surveillance of the quality of the analytical data
- To develop new analytical procedures as required to supplant or augment existing procedures

9.1 QUALITY ASSURANCE CRITERIA

Precision and accuracy provide criteria for evaluating test data. Precision refers to the reproducibility among repeated observations of the same sample. Accuracy refers to the degree of difference between observed and known, or actual, values. When precision and accuracy criteria are established, systematic checks to assess test data validity are possible. Procedures used for establishing precision and accuracy for the Shawnee analytical methods are given in Appendix K. These procedures follow EPA guidelines set forth in Reference 7.

9.2 EVALUATION AND MODIFICATIONS OF ANALYTICAL PROCEDURES

The first step in the quality assurance program was a comprehensive review of the analytical methods and equipment used at Shawnee. The available precision and accuracy data were used to identify problem areas. The methods judged to require improvement for the Advanced Test Program were the following:

Liquids

- pH
- Sulfite by titration
- Sulfate by titration

Solids

- Total sulfur, magnesium, and calcium by X-ray
- Total sulfur by the backup method (titration)
- Carbonate by CO_2 evolution

These methods are described in the Shawnee Chemical Procedures Laboratory Manual (Reference 6). The problem areas that have been identified are described in more detail below.

9.2.1 X-Ray Fluorescence Spectrometric Analysis

The precision of the X-ray fluorescence spectrometry method (Method 16, Reference 6) used to analyze for calcium, total sulfur, and magnesium in solid samples was excellent. Precision control limits are discussed in Appendix K.

The accuracy of the X-ray fluorescence method was less satisfactory. Several known samples were analyzed at the test facility for calcium, sulfur, and magnesium, and the results of the analyses are compared with the known values in Figures 9-1, 9-2, and 9-3. The accuracy of Method 16 was found to be a function of the composition of the solid and thus not amenable to the control chart techniques described in Appendix K.

On January 29, 1976, a new pellet preparation method (Method 17 in the Shawnee laboratory manual) was initiated with the objective of improving the accuracy of the calcium and sulfur analysis. This method uses lithium carbonate (Li_2CO_3) to dilute the solids, thereby reducing interferences from other species. The accuracy of the new procedure is being monitored.

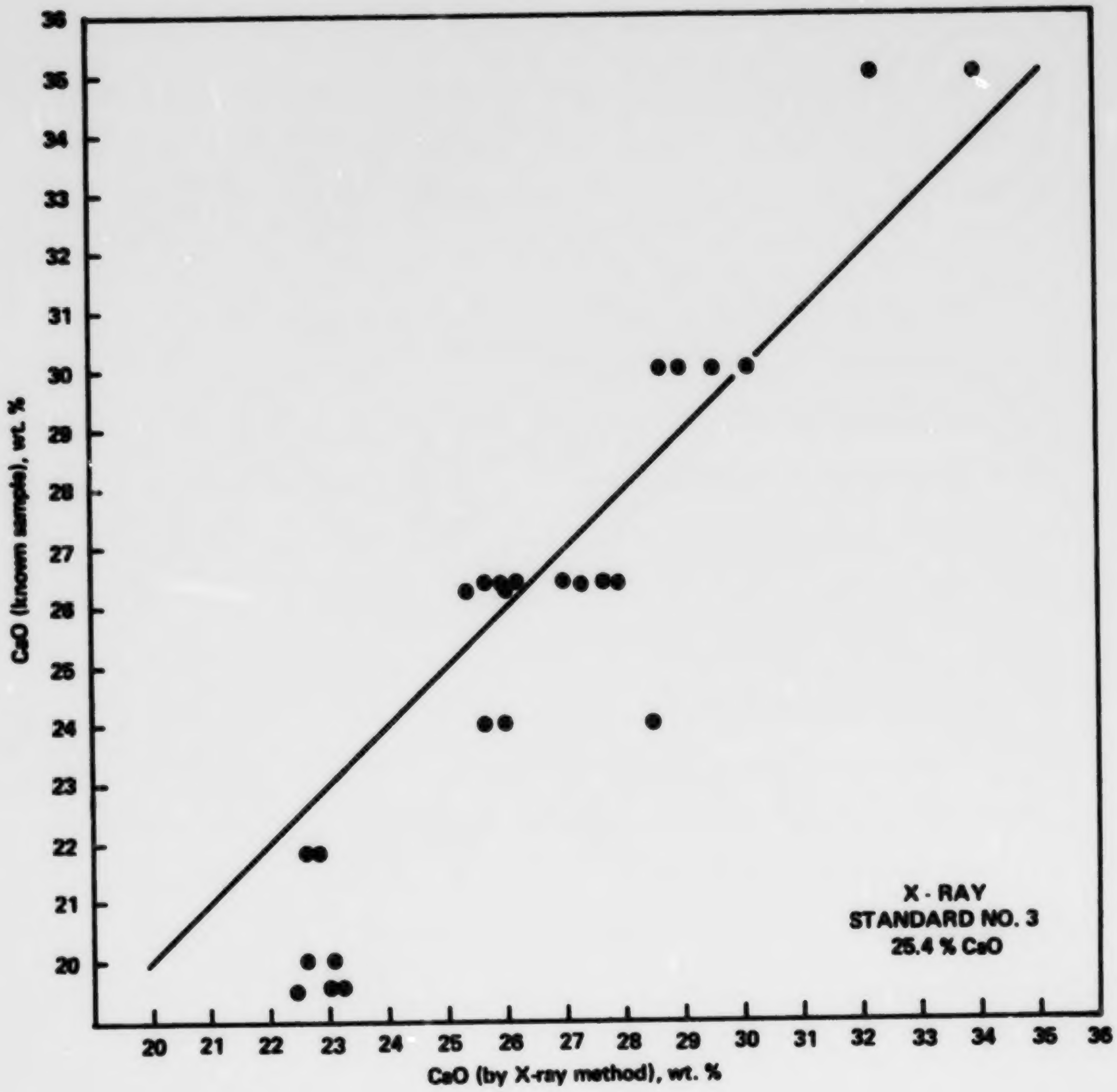

Figure 9-1. Results of Analysis for CaO by X-Ray Fluorescence Spectrometry with Known Values for CaO in the Prepared Samples

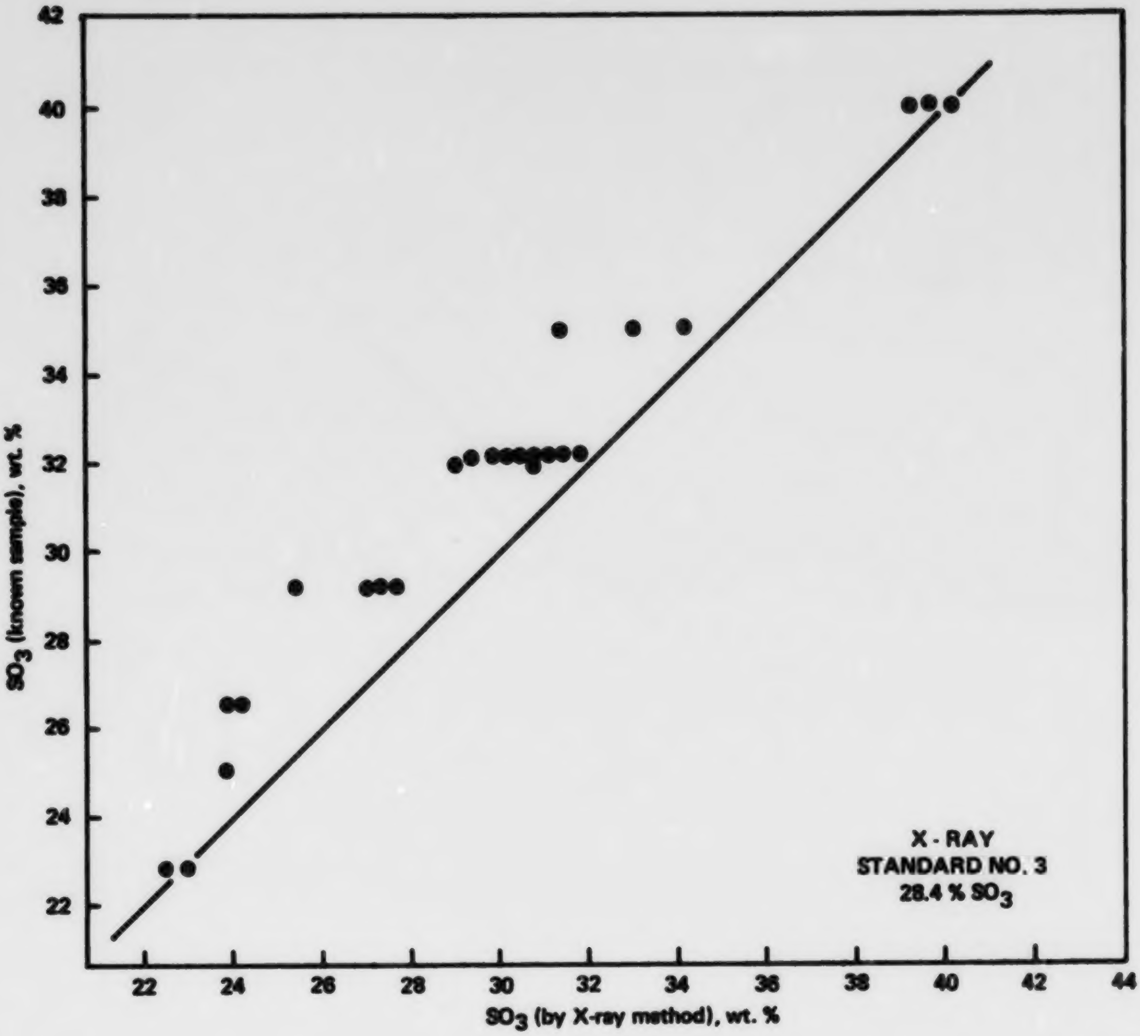

Figure 9-2. Results of Analysis for SO_3 by X-Ray Fluorescence Spectrometry with Known Values for SO_3 in the Prepared Samples

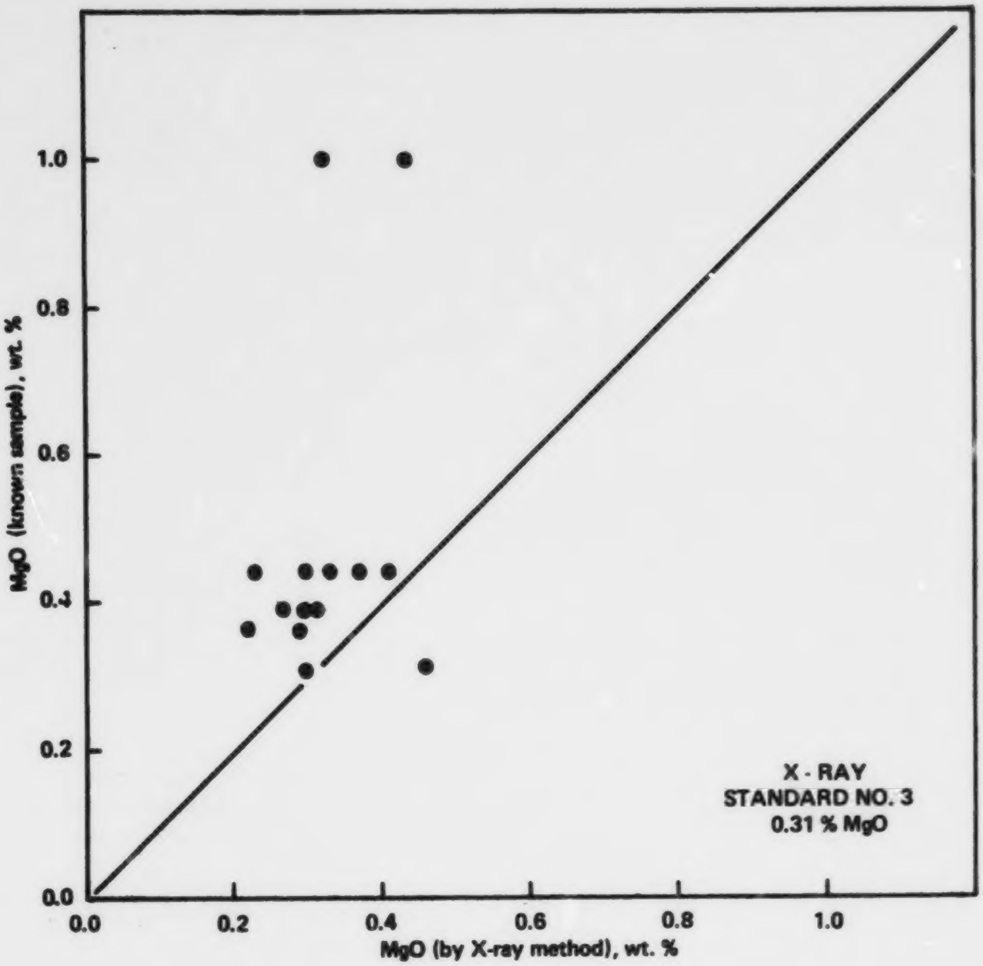

Figure 9-3. Results of Analysis for MgO by X-Ray Fluorescence Spectrometry with Known Values for MgO in the Prepared Sample

Equations to improve the accuracy of the older data by correcting for compositional interferences were developed from the analyses (Figures 9-1 and 9-2) of known samples. These equations will be applied to solids data collected prior to January 19, 1976. The equations are:

$$\%\ \mathrm{CaO\ (corrected)} = 0.083 \times (\%\mathrm{CaO})_{\mathrm{X\text{-}ray}}^{1.521} \times (\%\ \mathrm{fly\ ash})^{0.209}$$

$$\%\ \mathrm{SO3\ (corrected)} = 0.639 \times (\%\mathrm{SO_3})_{\mathrm{X\text{-}ray}}^{0.985} \times (\%\ \mathrm{fly\ ash})^{0.153}$$

where $(\%\mathrm{CaO})_{\mathrm{X\text{-}ray}}$ = weight percent calcium (as CaO) in the dry slurry solids found by Method 16 of Reference 6.

$(\%\mathrm{SO3})_{\mathrm{X\text{-}ray}}$ = weight percent sulfur (as SO_3) in the dry slurry solids found by Method 16 of Reference 6.

(% fly ash) = weight percent acid insolubles in the dry slurry solids found by Method 4 of Reference 6.

The multiple correlation coefficients of 0.95 and 0.99 for these equations indicate a good fit of the data.

Routine X-ray analysis of solids samples for magnesium was discontinued. The low atomic number of this element and its low concentration in the solids (less than 0.5 percent) made the results of such analysis doubtful (shown in Figure 9-3).

9.2.2 pH

A study of pH data-taking procedures was conducted in November and December 1975 to determine how to improve them. Several pH meters in use were experiencing difficulty. The glass electrodes required long periods (up to 20 minutes for some electrodes) to reach thermal equilibrium when transferred from buffer at ambient temperatures to slurries at scrubber temperature (125°F). The sample shack used for housing pH measuring equipment was crowded and inadequately heated.

As a result of the study, a formal procedure was adopted for measurement with the pH meters and electrodes. The revised pH procedure includes a 4-minute period to allow the glass electrode to reach thermal equilibrium at slurry temperature and a monthly equipment check to ensure correct pH values at slurry temperature as well as ambient temperature.

A new field laboratory was constructed to replace the sample shack. Slurry pH readings in the field lab were to be made only with a new Fisher Accumet Model 520 pH meter. This meter has an internal circuitry check that is useful for troubleshooting.

Tests were initiated to further improve the pH measurement process. This included testing of electrodes to see if electrode life expectancy can be increased by the use of hot baths for electrode storage between readings and use of hot buffers.

Preliminary results have shown that buffering the pH meter at scrubber temperature will improve the pH data. There are indications that storing the glass electrodes at scrubber temperature in a pH 4 buffer saturated with potassium chloride can increase the life expectancy of the glass electrodes. Combination glass electrodes with glass-to-glass seals between the electrodes and the sample solution are more suitable for slurry service at Shawnee than other types, such as those with rubber-to-glass seals.

The results of the pH study are detailed in a report entitled, pH Study at the Shawnee Test Facility -- Phase II, September 1976.

9.2.3 Sulfite

The sulfite analysis procedure (Method 7, Reference 6) was found to have a precision upper control limit of about 0.5 (see Appendix K). This means that the results of the analysis of a sample and its replicate could differ by a factor of 2 to 3 without exceeding the upper control limit. The amperometric cell and ammeter used in the amperometric titration procedure (discussed in the laboratory manual) were considered to have been major causes of error.

On February 5, 1976, the sulfite procedure was changed. A commercial amperometric titrator (Wallace and Tiernan Series A-790) replaced the cell and ammeter in use prior to that date. The new procedure is Method 8 in Reference 6. The instrument appears to be performing well, although accuracy and precision data for this new method are not yet available.

9.2.4 Sulfate

The ion exchange/titration procedure used at the test facility for sulfate analysis was investigated. Although the precision of this analysis (Method 9 in Reference 6) is acceptable (see Appendix K, Figure K-1), the results of the accuracy samples analyses (shown in Appendix K) indicated that this procedure produces unsatisfactory values. The average error [(Found-Actual)/(Actual)] for 15 analyses was +28 percent.

A turbidimetric method (such as described in Reference 7) that would not require ion exchange and would be relatively free of interferences is being investigated to replace the titrimetric method currently in use.

9.2.5 Carbonate

Accuracy data for the solid carbonate analysis procedure (Method 5 in Reference 6) were not available. However, the precision data available

(Appendix K, Figure K-2) suggested that this method needed to be improved or replaced.

Development of a new carbonate procedure was initiated at the site employing the nondispersive infrared (NDIR) equipment described in Method 6 of Reference 6. If this method proves to have acceptable precision and accuracy, it will replace the CO_2 evolution method (Method 5 in Reference 6).

9.3 CURRENT QUALITY ASSURANCE MEASURES

The ongoing laboratory quality assurance program at Shawnee includes the following:

- Daily review of analytical data to determine whether expected trends are followed
- Replicates of regular samples (providing data for precision control charts)
- Analysis of accuracy samples (providing data for accuracy control charts)
- Improvements in old procedures and the development of new procedures on the basis of precision and accuracy data as they become available

The program also includes documentation of equipment status, including equipment inventories, equipment checkout results, and equipment operating histories.

Section 10

OPERATING EXPERIENCE DURING LIME/LIMESTONE TESTING

This section summarizes the operating experience during lime/limestone testing at the Shawnee Facility from June 1975 through mid-February 1976. Summaries of prior operating experience are presented in References 1 and 2.

10.1 SCRUBBER INTERNALS

10.1.1 Mist Eliminators

Reliable mist eliminator performance has been linked to percent alkali utilization, with better reliability occurring at higher alkali utilizations. A review of mist eliminator performance during utilization testing is presented in Subsection 8.4.

10.1.2 TCA Grid Supports

The 3/8-inch-diameter, 316 stainless-steel bar-grids, installed on 1-1/4-inch centers in October 1973, have been in slurry service for approximately 16,000 hours with no evidence of significant erosion.

10.1.3 TCA Spheres

In June 1975, three beds of 6-gram thermoplastic rubber (TPR) hollow spheres, each containing 10,000 spheres, were installed in the TCA. Although these spheres were expected to reduce the dimpling previously experienced with 5-gram spheres, a significant reduction in dimpling did not occur. The failure rate for these spheres is plotted in Figure 10-1. After 3800 hours of testing, approximately 11 percent of the spheres had failed from splitting at the seams. The average weight losses for the unsplit spheres in each bed were: 12.0 percent at the top, 9.2 percent in the middle, and 7.7 percent at the bottom. Most of the testing was performed at 12.5 ft/sec scrubber gas velocity and 15 percent solids recirculated. As indicated in Figure 10-1, 1500 TPR spheres were added to each of the top and middle beds in November 1975 to make up for previous sphere losses.

All the TPR spheres were replaced by new 6.5-gram nitrile solid foam spheres in December 1975, and 7500 of these new spheres were installed in each of the three 5-inch beds. After 240 hours of operation, a sample of the spheres was removed and examined. The spheres still had their original color and looked clean, although they had lost their smooth, new appearance. The surfaces were slightly roughened, open pores were visible under a microscope, and mold seams were still apparent. The spheres did not look wet, nor could water be squeezed

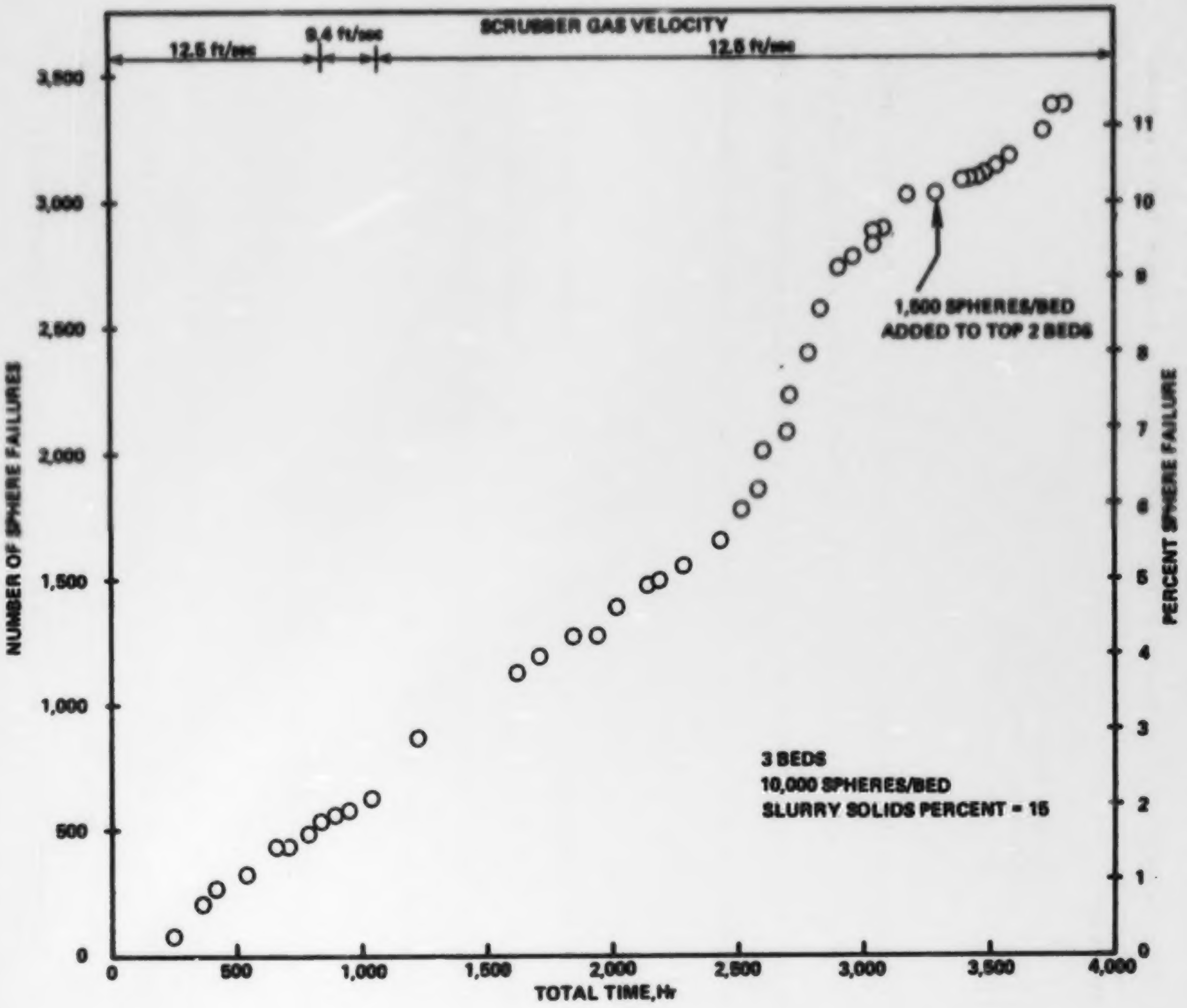

Figure 10-1. Failure Rate of 6-Gram TPR Spheres in Limestone/ Fly Ash Slurry Service

from them, but prior to drying they weighed approximately 9 percent more than new, unused spheres. After drying for 3 days at 45°C to 60°C, comparison of the new and used spheres showed for the used spheres:

Weight loss = 1%
Diameter loss = 9%
Volume loss = 25%

Since the mold seams were still visible and since there was little weight loss after drying, it is presumed that the spheres merely shrunk. After 574 hours of operation, the spheres were again sampled and after acid washing and drying, they were unchanged from their condition after 240 operating hours.

In early February 1976, the old spheres were replaced with new 6.3-gram nitrile foam spheres. These new spheres are being closely monitored to better document the apparent shrinkage. Results will be presented in a later report.

10.1.4 Spray Tower Nozzles

The nozzles being tested in the venturi/spray tower system are Bete No. ST48FCN stellite-tipped nozzles installed in March 1974. The stellite tips have decreased approximately 40 percent in weight during 11,700 hours of service. Wear rate was greater in limestone service than in lime service.

Wear on the inside of the 316 stainless-steel base has been significant, occasionally causing detachment of the nozzles. Making the base out of stellite should eliminate this problem. The nozzles have operated at 10 psi pressure drop for 9450 hours with 8 percent solids slurry (lime), and for 2250 hours with 15 percent solids slurry (limestone)

10.1.5 TCA Nozzles

The four TCA slurry feed nozzles were installed in September 1974. These were Spraco No. 1969F full-cone, open-type nozzles, made of 316 stainless steel. No significant wear has been observed after 9000 hours of operation at a 5 psi pressure drop with slurry containing 15 percent suspended solids. The low wear rate is probably due to the low pressure drop across the nozzles.

10.1.6 Venturi Internals

The venturi at Shawnee is a variable-throat, 316L stainless-steel type manufactured by Chemical Construction Corporation (Chemico). During the current operating period, both erosion and minor corrosion have continued, as indicated in the following discussion of specific internal components.

As noted in Reference 2, inspection after shutdown for the May 1975 boiler outage revealed stress cracking on the portion of the inlet duct that extends into the venturi. Since then, two more pieces of the 40-inch duct extension at the venturi inlet have failed. Because the failures do not significantly affect system operability, repair has been delayed until a shutdown of sufficient length can be scheduled.

Erosion of the bull nozzle, plug guide vanes, and plug shaft sleeve flanges has continued. To prolong the life of the guide vanes and to test materials of construction, the vanes have been covered with expendable materials or rubber shields. A discussion of the materials used through April 1975 can be found in TVA's Third Interim Report on Corrosion Studies, Appendix L of this report. Materials tested after April 1975 will be covered in a Fourth Interim Report on Corrosion Studies.

The only corrosion experienced in the venturi has been minor pitting (see Appendix L).

It should be emphasized that solids buildup at the hot-gas/liquid interface in the venturi entrance has never been significant, contrary to the experience at some installations.

10.2 REHEATERS

Flue gas from the scrubber is reheated to prevent condensation and corrosion in the exhaust system, to facilitate isokinetic and analytical sampling, to protect the induced-draft fans from solid deposits and droplet erosion, and to increase plume buoyancy.

The original in-line, fuel-oil-fired units (supplied by Hauck Mfg. Co.) have both been modified to incorporate a fuel-oil-fired external combustion chamber (manufactured by Bloom Engineering Co.). Reasons for the changes are discussed in Reference 1. Both of the units have operated reliably with minimum flameout and equipment problems for over 13,700 hours on the venturi/spray tower system and 4400 hours on the TCA system. A major repair of the refractory in the Bloom reheater on the venturi/spray tower system was made during the May 1975 boiler outage. Repairs were made by using a mixture of 15 percent Kaocrete and 85 percent Kruzite castable #32 refractory (A.P. Green Co., Mexico, Missouri).

10.3 FANS

The 316L stainless-steel fans at the Shawnee Test Facility are induced-draft, centrifugal fans manufactured by Zurn Industries. Reliability has been good during the current operating period, with no system downtime due to fan problems.

During the May 1975 boiler outage, a 4-inch hairline crack was discovered in the fan rotor shroud of the venturi/spray tower fan. The crack was repaired by welding with a Type 347 stainless-steel rod and grinding the weld smooth.

Ease of cleaning the fans, fan dampers, and ductwork between the dampers and reheaters has been greatly increased by the use of a new portable steam generator. The unit has also been useful in thawing frozen lines during winter.

10.4 PUMPS

The major pump problem during the current operating period (see Reference 1 for a report on prior operation) has been pump seal failure. The seals on the rubber-lined centrifugal pumps (manufactured by Allen-Sherman-Hoff) are air-flushed packings. The frequency of repacking of the 20 to 100 gpm pumps has been minimized by maintaining the clearance between the shaft and the pump casing at 10 to 15 mils.

In another attempt to solve seal problems at Shawnee, mechanical seals have been tested on various centrifugal pumps. These tests are part of the equipment components testing program, and the results are covered in detail in Subsection 10.8.2.

10.5 WASTE SOLIDS HANDLING

10.5.1 Filter

Because of frequent cloth failure and cake discharge difficulties, the Maxibelt rotary-drum vacuum filter was converted from a roll discharge type to a snap-blowback discharge type in February 1975. The filter cloth life has been extended by this change but is still considered too short. The major reasons for cloth failures have been tearing and blinding. Table 10-1 summarizes details of the cloths tested at Shawnee. A program will be initiated to determine both the reason for the continuing short cloth life and the steps necessary for improvement.

10.5.2 Centrifuge

The centrifuge being used at Shawnee is a solid-bowl continuous type manufactured by Bird Machine Co. Owing to severe erosion, the surface of the original unit required rehardening after 1400 hours of operation. Since repair, a total of 3500 hours of satisfactory intermittent operation has been achieved.

10.5.3 Clarifiers

The 6-foot feedwell extension on the TCA clarifier (8 feet total), installed during the May 1975 boiler outage, has proved successful in

Table 10-1

SUMMARY OF FILTER CLOTHS TESTED AT SHAWNEE

Cloth	Material	Number Tested	Longest Cloth Life, hr
Ametek STE-F908-HJO	100% olefin	6	603
Lamports S/4048-SHS	Polyester (Dacron)	4	203
Lamports 7512-SHS	Multifilament polypropylene	8	642

reducing clarifier upsets and subsequent high solids content in the clarifier overflow.

10.6 ALKALI ADDITION SYSTEMS

10.6.1 Lime

The lime addition system consists of a storage silo, a screw feeder, a lime slaker (manufactured by Portec-Cahaba), a slaked-lime holding tank, and associated feed pumps. An analysis of the lime used can be found in Appendix C. Fresh water slakes the lime to approximately 20 to 25 weight percent solids. The system has given excellent reliability in over 15,800 hours of intermittent operation. Plugging of the lime addition lines by gradual buildup of grit that gets through the slaker screen has been reduced by placing a screen over the entrance to the slaked lime slurry hold tank.

10.6.2 Limestone

The limestone addition system consists of a drying-grinding system, a dry storage tank, a belt feeder, a slurry tank, and associated feed pumps.

The drying-grinding system was installed during an earlier EPA-sponsored dry-limestone injection program at the Shawnee Power Station.

The only major repair during the current reporting period was the relining of the dryer fire box. Generally, it has given satisfactory performance with low maintenance during the 4 years of the alkali wet-scrubber test program.

The slurry addition system was modified to provide 60 weight percent limestone slurry in November 1972 and was further modified to incorporate clarified process liquor for slurrying the limestone in March 1974. Since March 1974, the system has continued to operate satisfactorily for an additional 11,400 hours of intermittent operation with little maintenance.

The alkali addition system pumps are positive displacement pumps manufactured by Moyno Pump Division of Robbins & Myer Co. They were installed in November 1972 when the limestone system was converted to provide a 60 weight percent limestone slurry. The pumps are oversized by a factor of 2. They are allowed to wear until the required flow can no longer be maintained. Typical operating life for a rotor is 2000 hours and for a stator, 1000 hours.

A composition and size distribution analysis of the ground limestone can be found in Appendix C.

10.7 INSTRUMENT OPERATING EXPERIENCE

10.7.1 pH Meters

The main problem associated with the Uniloc Model 321 submersible pH meters (Universal Interloc, Inc., Santa Ana, Calif.) used to measure scrubber liquor pH has been occasional scale formation on the probes. This scale causes measurement error and is removed by rinsing with hydrochloric acid. All probes are routinely rinsed with water about twice a week and calibrated when necessary.

In April 1975, a short period of testing was conducted using a continuous ultrasonic cleaner (a Uniloc add-on) to aid in the prevention of scale buildup. The cleaner was effective at preventing heavy scale buildup when operating in a highly scaling mode.

Current operating experience with lab pH meters is covered in Subsection 9.2.2.

10.7.2 Flow Meters

In Reference 1, it was reported that the Adiprene L-liner in the 1-1/2-inch Foxboro magnetic flow meters deteriorated. Subsequently, it was noted that these liners were tapered in thickness near the meter exit while all the other meter sizes had a uniform lining thickness. As a result, the meters were relined with Adiprene-L of uniform thickness, and since that time no liner failures have been experienced.

Satisfactory meter accuracy can been maintained by electrical purging once per shift and flow checks approximately once every 3 months.

10.7.3 Level Measurement

Three Brooks Maglink 5300 Series level indicators were installed in scrubber effluent hold tanks D-101, D-201, and D-208 for evaluation at the Shawnee Test Facility. The Brooks indicator consists of a vertically mounted standpipe or stilling chamber fastened externally or internally to the side of a tank, with a bottom liquor inlet to the chamber. Slurry level is detected by a donut-shaped float surrounding a small center pipe running the length of the stilling chamber. A magnet inside the sealed center pipe moves with the float and provides a level signal from its position.

The initial problem was solids buildup on, and eventual immobilization of, the float. A liquor flush stream was installed to eliminate the problem, but the following difficulties are occasionally encountered.

- Floating material still causes occasional immobilization of the float.
- The flush system liquor stream impinges on the float, causing float depression and reading error. The magnitude of the error is variable and dependent on the distance the purge stream free falls prior to impingement on the float.
- Dislodging an immobilized float can uncouple the magnet. Reactivating the system can take several manhours.
- Modifying the measurement range requires the installation of a new gear drive.

However, when properly maintained and calibrated and when a constant flush of about 2 gpm of slurry or clarified liquor is used, the Brooks indicator will measure the slurry level in the effluent hold tank to within 6 inches. A dipstick level measurement is used routinely to check the Brooks indicator.

10.7.4 SO_2 Meters

Operation with the Du Pont Model 400 UV SO_2 analyzers has been essentially trouble-free during the current operating period. The units are calibrated on Monday, Wednesday, and Friday of each week using a set of calibrated filters.

10.7.5 Density Meter

The Dynatrol density meter continues to give trouble-free operation.

10.8 MATERIALS AND EQUIPMENT EVALUATION PROGRAM

10.8.1 Materials

Lining or coating materials for equipment at the Shawnee Facility generally consist of neoprene rubber (pipes, pumps, scrubber internal walls, and small tanks) or Flakeline 103 (effluent hold tanks and clarifiers). Flakeline 103 is a bisphenol-A type of polyester resin filled 25 to 35 percent with glass flake. It is manufactured by Ceilcote Company.

Both rubber and Flakeline coatings have shown very little erosion or other deterioration. However, a Flakeline 103 test panel-mounted inside one of the TCA beds did exhibit significant wear. Successful repairs have been made using Epoxylite-203 (Epoxylite Corp, Anaheim, California), an epoxy resin formulated with selected fillers, making a paste material. The resin is cured with Epoxylite's No. 301 amine hardener. A patch on the venturi/spray tower effluent hold tank agitator blade has shown little wear after over 13,500 hours.

The Third Interim Report of Corrosion Studies at the test facility, written by TVA, is presented in Appendix L. The report covers the operating periods from October 1973 through April 1975 and discusses corrosion and erosion of the test facility equipment and the results of the materials of construction evaluation carried out simultaneously. Results for the current operating period will be presented in the Fourth Interim Report.

10.8.2 Equipment

A program to evaluate selected mechanical components has been initiated at the Shawnee Test Facility. Plastic pipe, butterfly and knife gate valves, Hayward line-strainers, mechanical seals, an orifice plate, and several Ceilcote lining materials are currently being evaluated. Results are summarized in this section.

Plastic Pipe. High-impact polyvinyl chloride pipe was installed on the suction line of the TCA slurry recycle pump (G-201) during the current operating period. The piping consists of one Tee, one 90° elbow, a 120° "S", and 2 feet of straight pipe. After 31.63 hours carrying a 15 percent slurry at 10 ft/sec velocity, the pipe was removed. Inspection revealed essentially no occurrence of erosion. A section of Bonstrand Series 4000 fiberglass-reinforced plastic pipe was then installed in the same spot and is currently being tested.

Butterfly Valves. A 6-inch Durco manual block valve (throat and disc coated with abrasion-resistant polyethylene) and a Valtek 6-inch butterfly control valve are being evaluated.

The Durco valve is located in the pump G-204 discharge line (G-204 feeds two of the spray tower headers). A total of 3700 hours of service in 8 percent slurry at approximately 9 ft/sec slurry velocity through the valve (in full-open position) resulted in a 4.5-mil loss of the disc coating thickness. This represents about 10 percent of the total coating thickness. The throat liner was in good condition, and there was no leakage through the valve when it was leak-tested at 55 psig.

The Valtek valve is also located in the G-204 pump discharge line. After approximately 3000 hours of service, hairline cracks appeared in the valve body and the disc experienced some slight erosion. Use of the valve for control has been attempted only at 700 to 800 gpm, and at that flow rate control has been good.

Knife Gate Valves. The knife gate valves being tested at Shawnee are Fabri-Valve 316 stainless-steel valves. Two 8-inch Figure 45 and two 8-inch Figure 37 valves are installed as block valves at the inlet and outlet of the parallel Hayward basket strainers in the discharge of pump G-201 (TCA slurry recycle pump). Four 6-inch Figure 37 valves are installed on the inlet and outlet of the Hayward strainers on the discharge of pump G-204.

Initial experience with the valves was poor. A hard scale formed on the surface of the gate, causing abrasion, flattening, and displacement of the neoprene O-rings in the valve seat. Often a displaced O-ring lodged between the gate and seat, causing the valve to leak. Experience has shown that without the O-rings, the valve seats without leaking, but the valves become difficult to open and close. Erosion has been negligible after more than 4000 hours of operation.

Line Strainers. Two Hayward single-basket line-strainers were installed in parallel at the discharge lines of both pump G-204 and pump G-201 as replacements for the failed Elliot line-strainers. After approximately 3700 hours of service, the iron body of the strainer was severely eroded in several areas. The 316 stainless-steel baskets (30-mil thick with 3/8-inch-diameter perforations) have not eroded significantly.

Mechanical Seals. Durametallic type "CRO" mechanical seals were installed on pumps G-105 (venturi/spray tower system bleed) and G-205 (TCA system bleed). The seal on G-105 failed after approximately 1500 hours of service; however, one of its carbon inserts was broken when it was installed. The seal on G-205 is still performing well after more than 4000 hours of service.

Orifice Plate. A 316 stainless-steel orifice plate equipped with a diaphragm DP cell for flow measurement is being tested in the line downstream from pump G-204. After 12,000 hours of operation, the plate is still in good condition with very little erosion or corrosion.

Chemical scale, however, deposits on the diaphragms, resulting in a measurement inaccuracy of about 15 percent after 2 weeks of service. Frequent cleaning of the diaphragms is necessary to keep the orifice meter calibrated.

Ceilcote Lining Materials. Plates of 316 stainless-steel were coated with Ceilcote materials by the Ceilcote Company and mounted at several locations inside the TCA scrubber to test these materials as scrubber liner materials. Flakeline 103, Coroline 505AR, and Flakeline 151 are being tested. After approximately 4000 hours, except for mechanical damage which was done by workers in the scrubber, the only panel that has undergone significant erosion or chemical attack is the panel mounted inside a TCA mobile bed. The panels will be returned to Ceilcote Company in June 1976 for final evaluation.

Future Evaluations. Scheduled for future testing and evaluation are both Metritape and sonic tank level sensors, a Moyno positive displacement pump for long distance pumping, a cone-diaphragm check valve in clarified liquor service, and both polybutylene and PVC pipe for slurry circulation.

Section 11

REFERENCES

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Appendix A

CONVERTING UNITS OF MEASURE

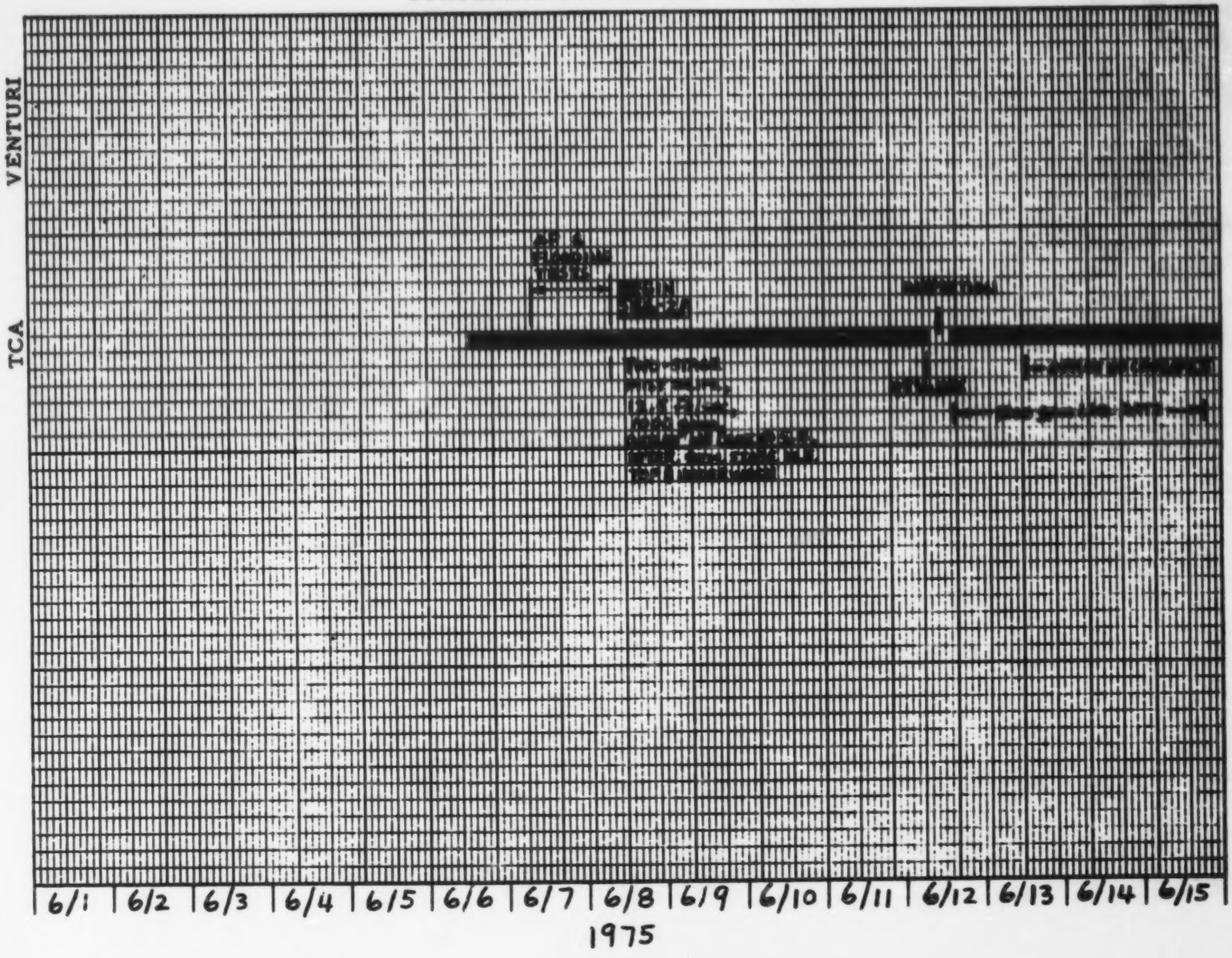
Environmental Protection Agency policy is to express all measurements in Agency documents in metric units. When implementing this practice will result in undue costs or lack of clarity, conversion factors are provided for the non-metric units used in the report. Generally, this report uses British units of measure. For conversion to the metric system, use the following conversions:

To Convert From	To	Multiply By
scfm (60°F)	nm^3/hr (0°C)	1.61
cfm	m^3/hr	1.70
°F	°C	(°F-32)/1.8
ft	m	0.305
ft/hr	m/hr	0.305
ft/sec	m/sec	0.305
ft^2	m^2	0.0929
ft^2/tons per day	m^2/metric tons per day	0.102
gal/mcf	l/m^3	0.134
gpm	l/min	3.79
gpm/ft^2	$l/min/m^2$	40.8
gr/scf	gm/m^3	2.29
in.	cm	2.54
in. H_2O	mm Hg	1.87
lb	gm	454
lb-moles	gm-moles	454
lb-moles/hr	gm-moles/min	7.56
lb-moles/hr ft^2	gm-moles/min/m^2	81.4
lb-moles/min	gm-moles/sec	7.56
psia	kilopascal	6.895

Appendix B

SCRUBBER OPERATING PERIODS

SCRUBBERS OPERATING PERIODS



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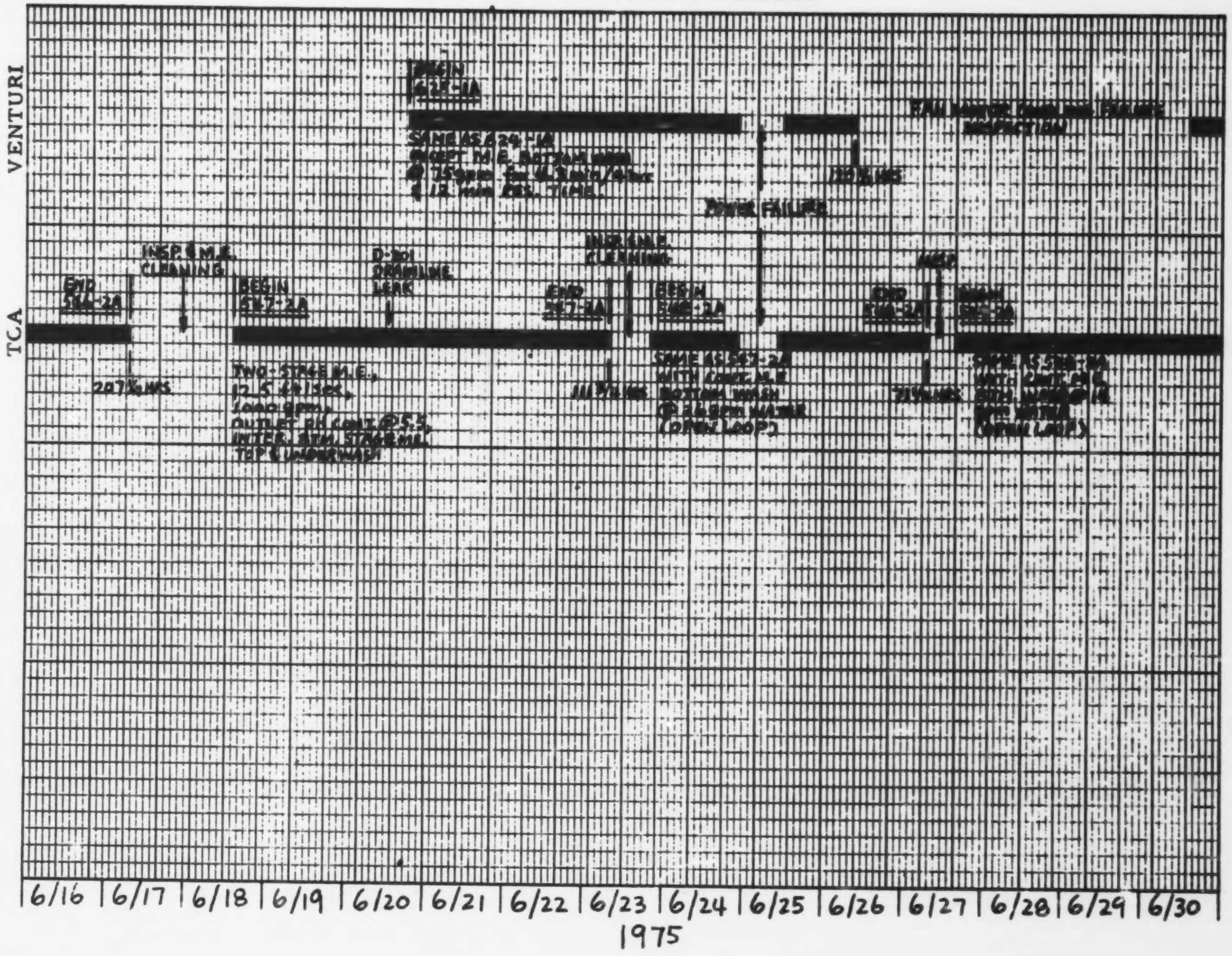

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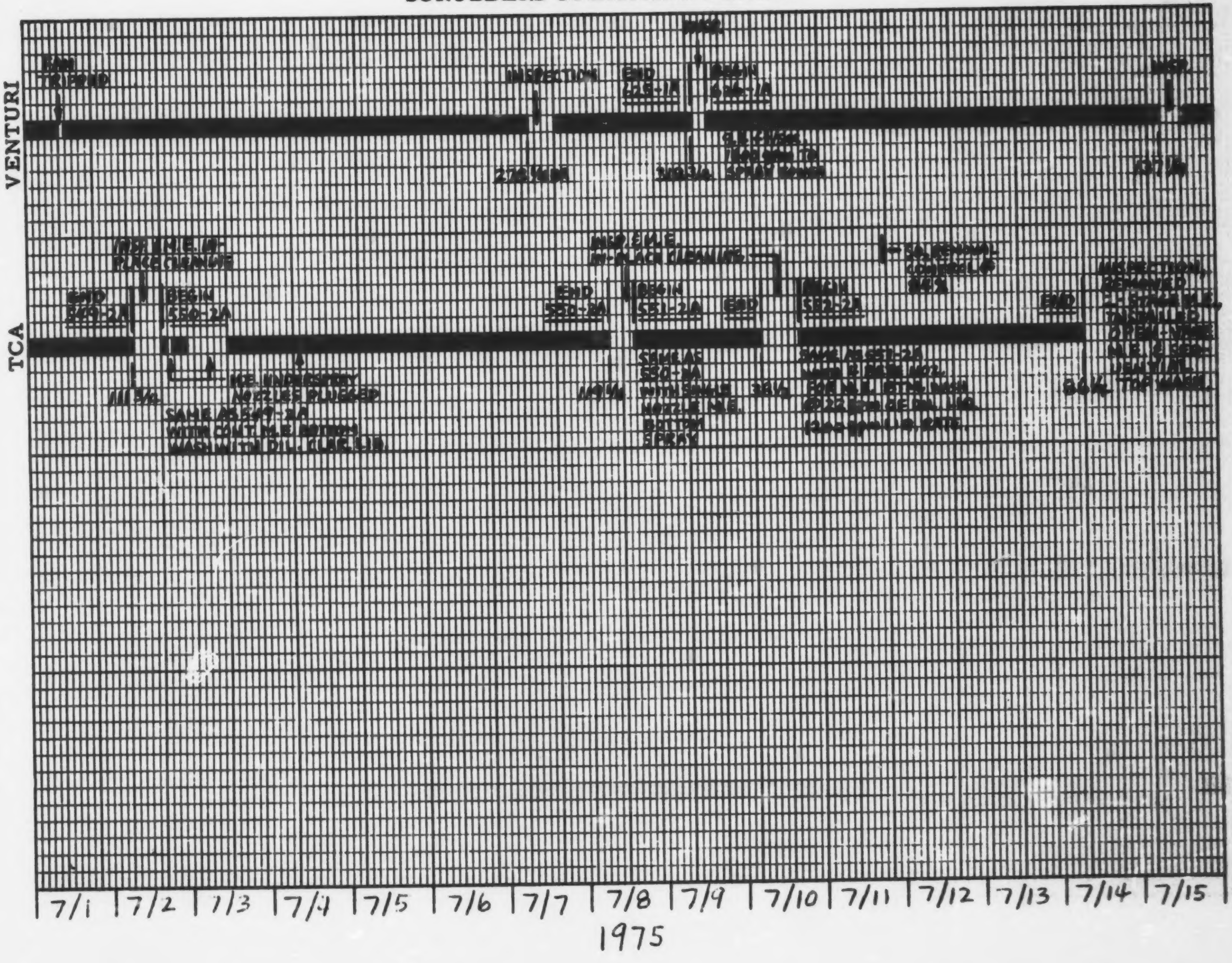

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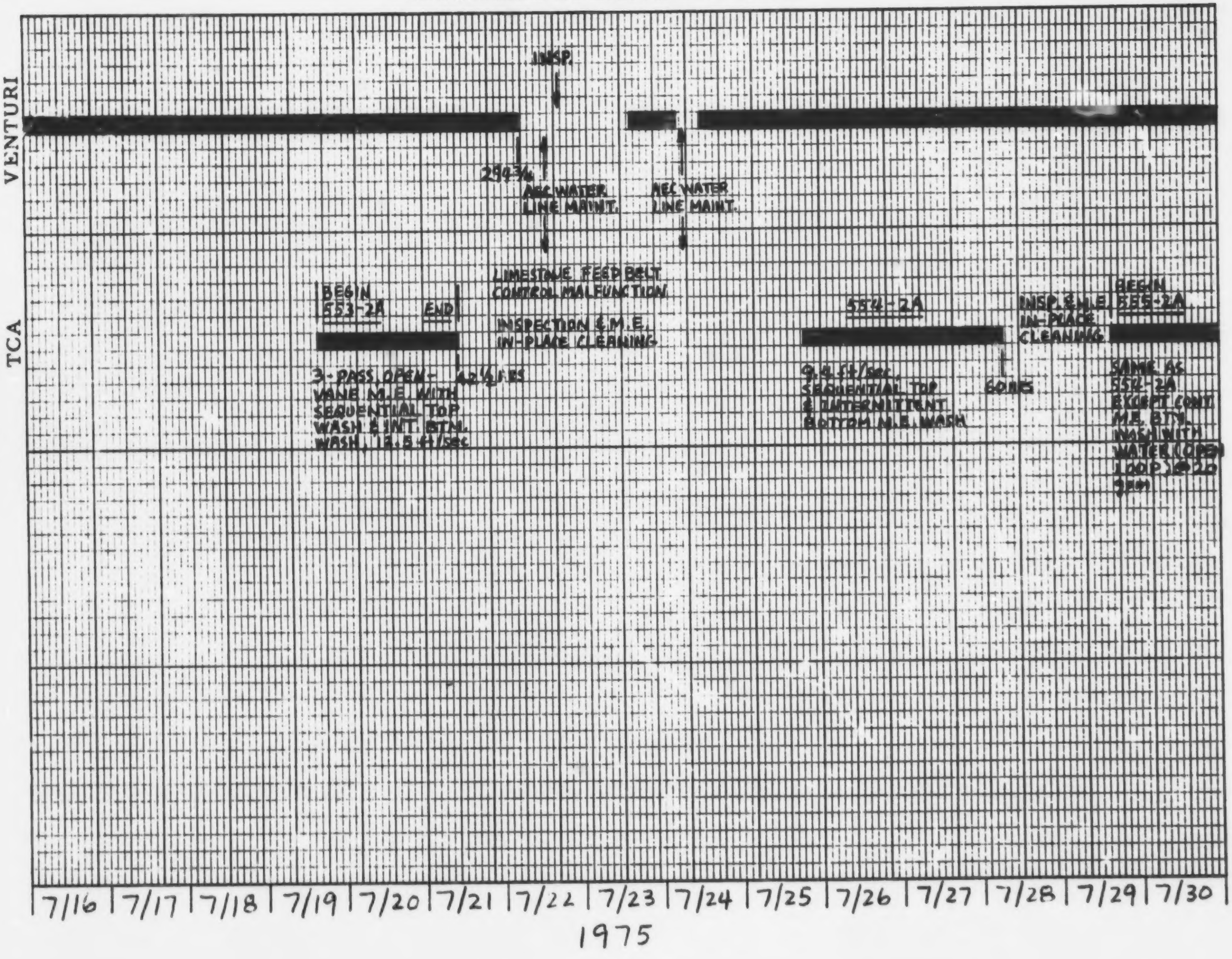

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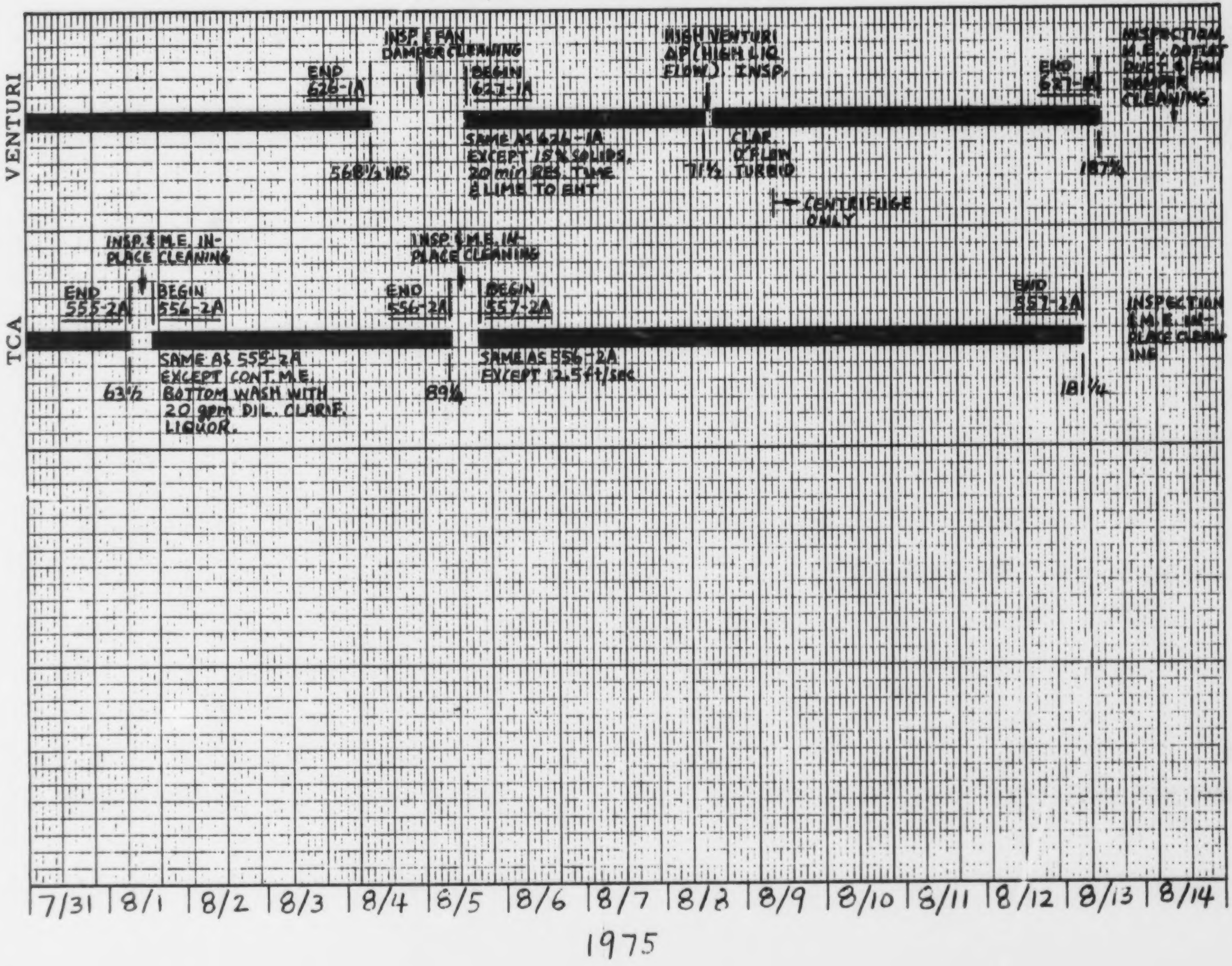

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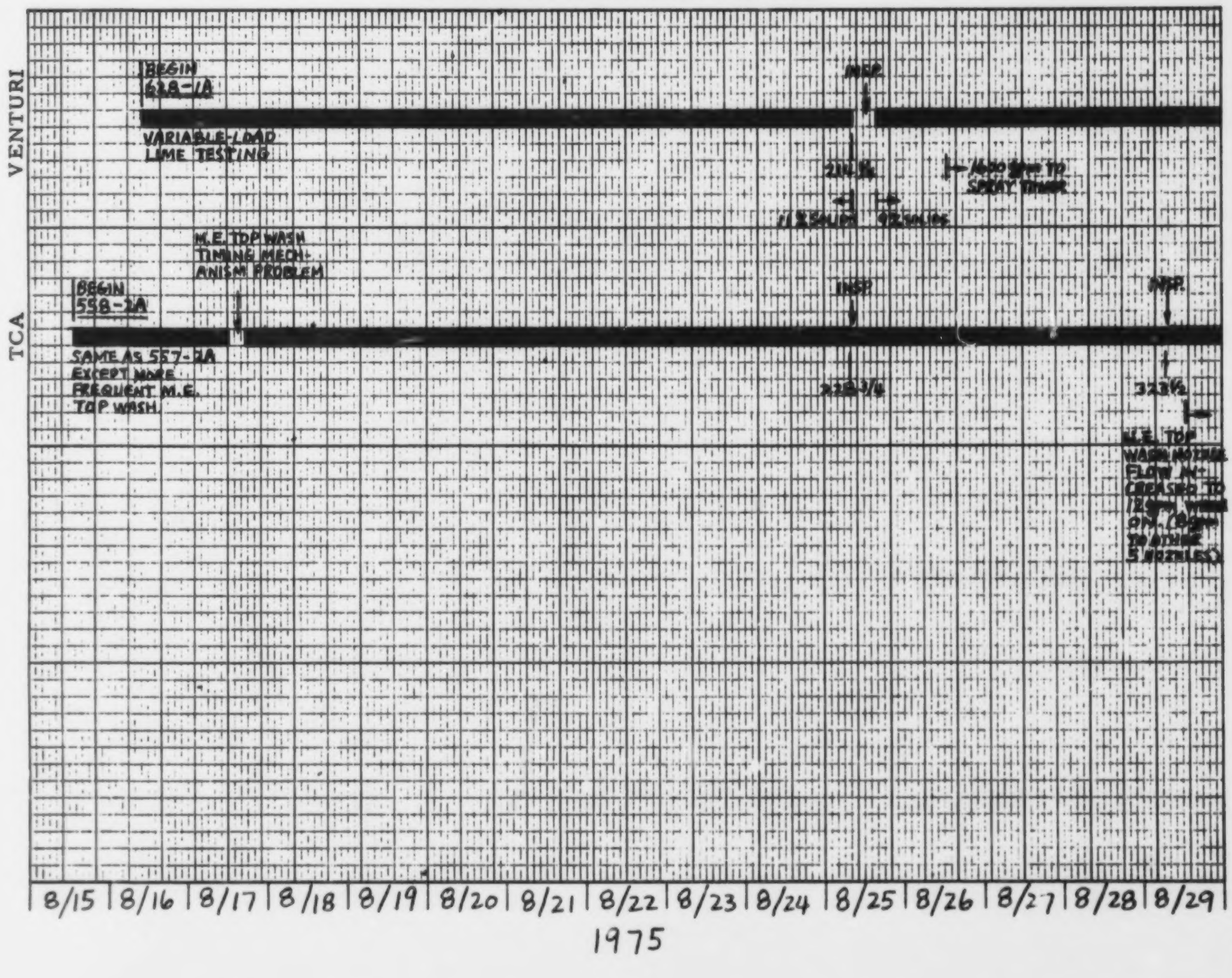

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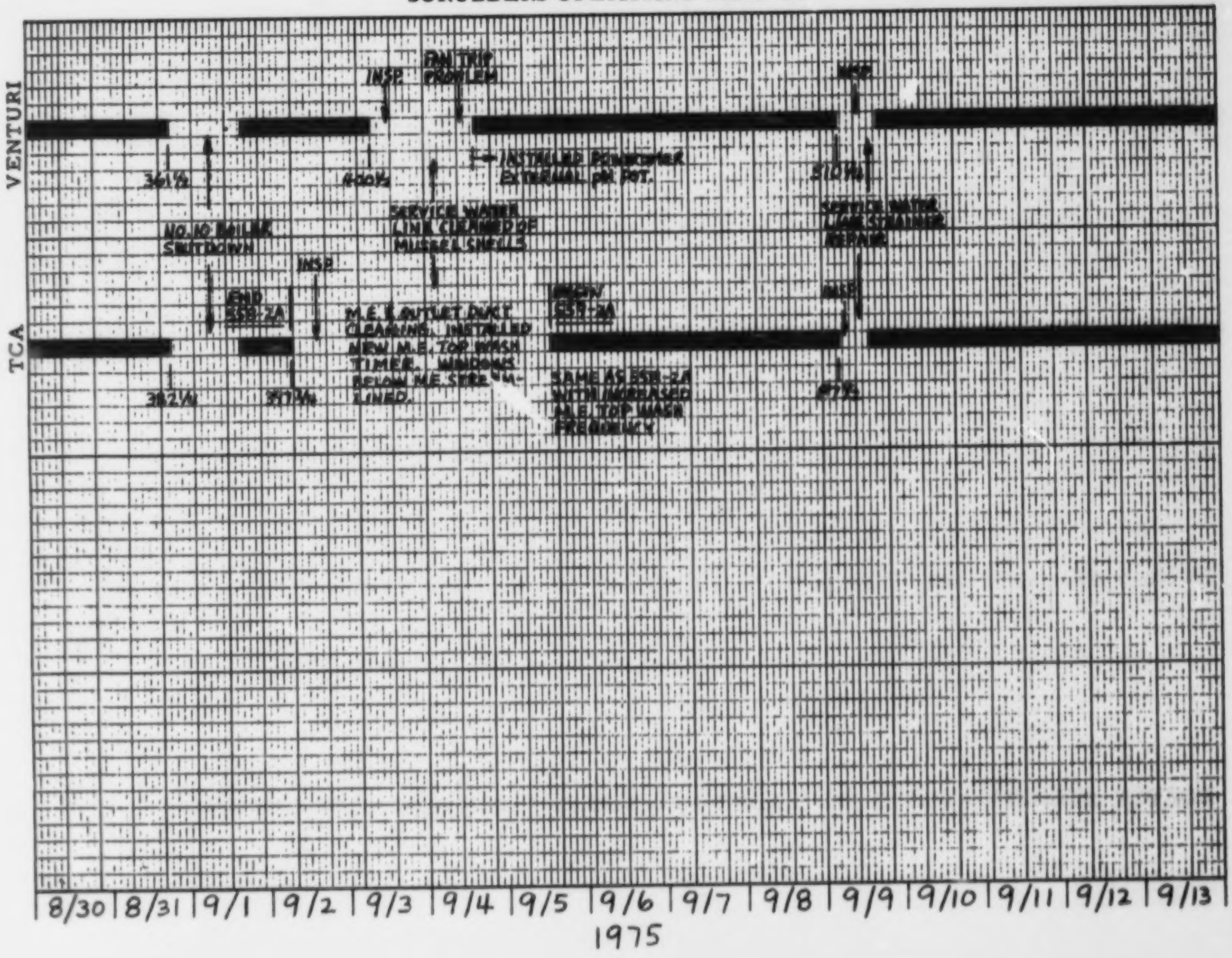

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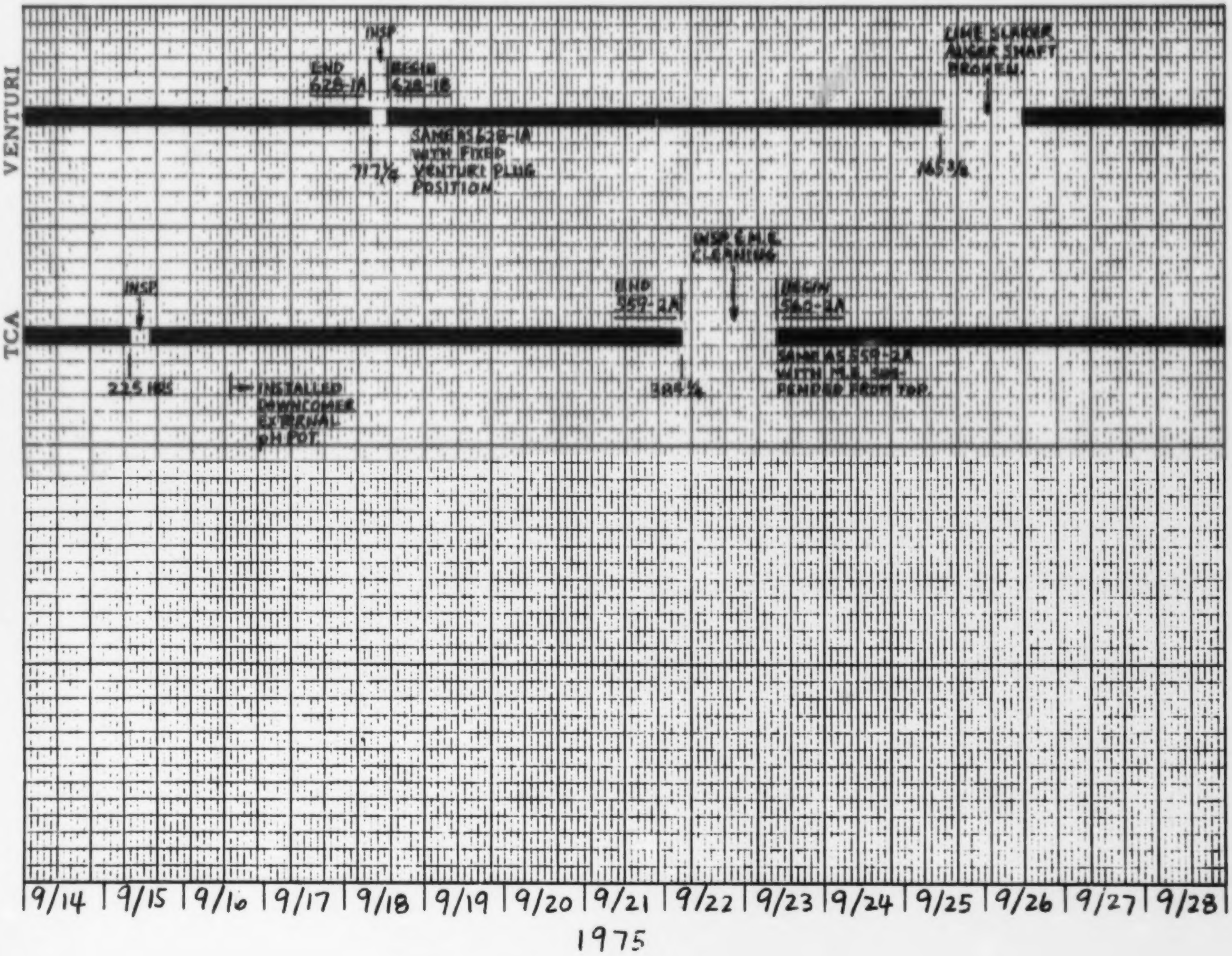

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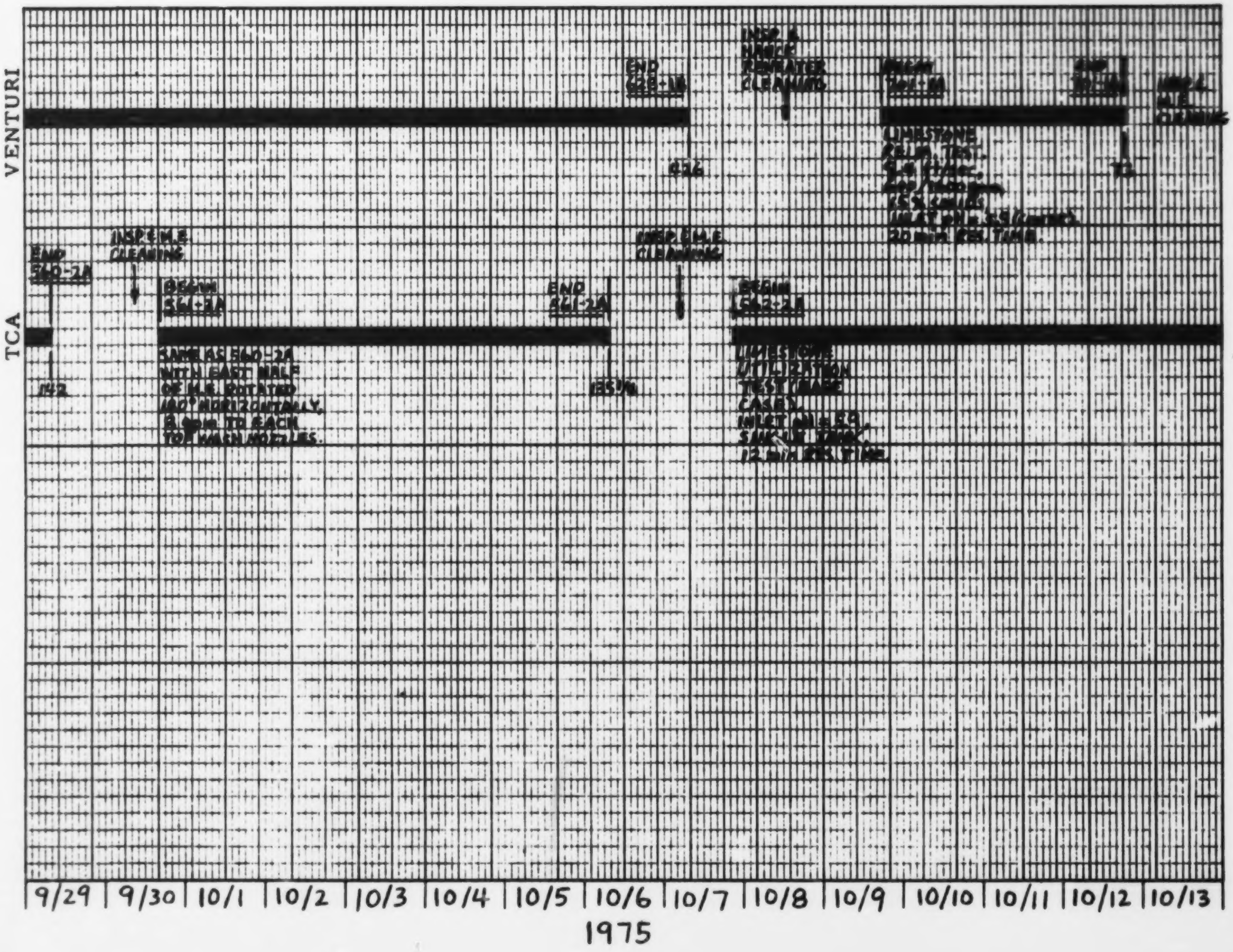

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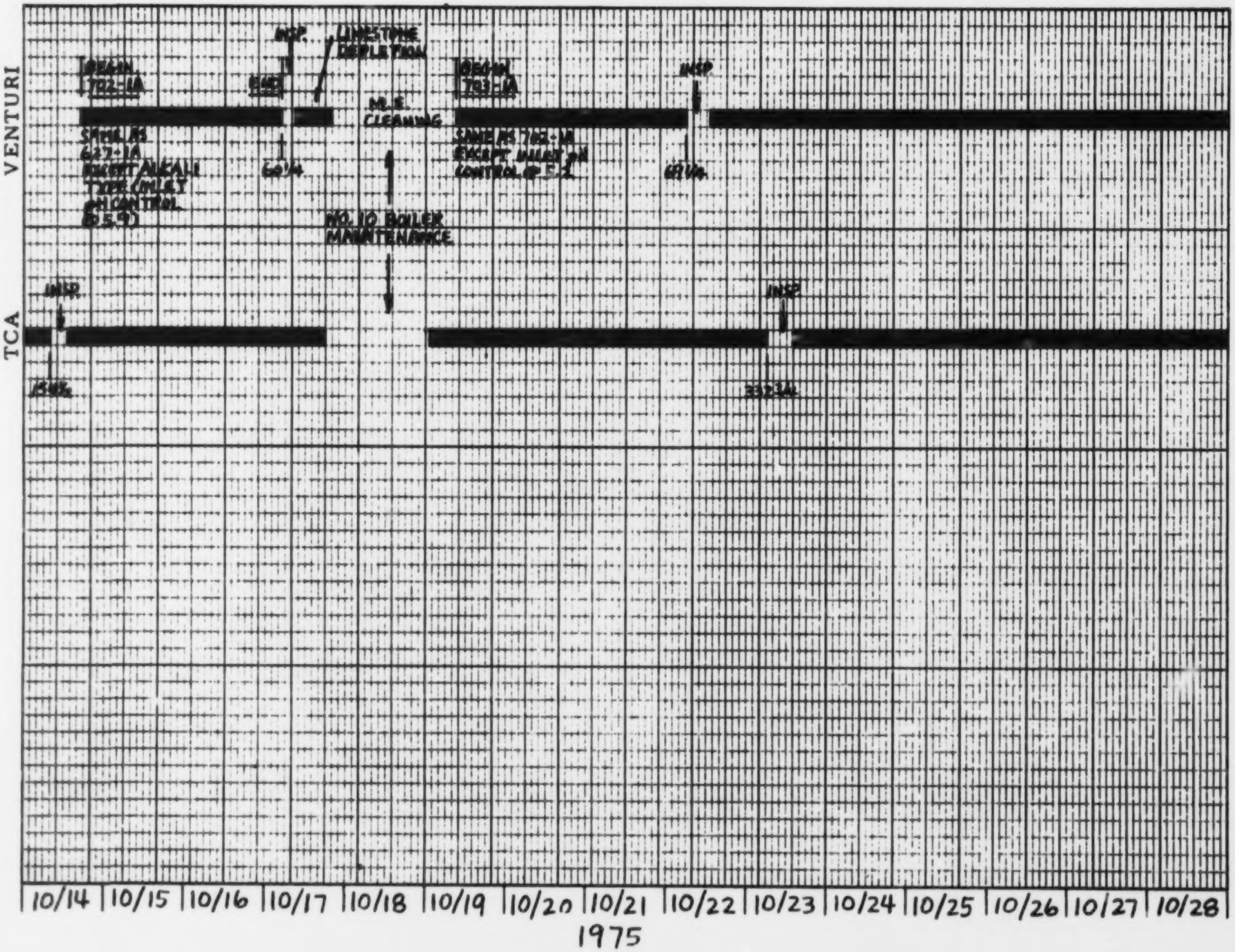

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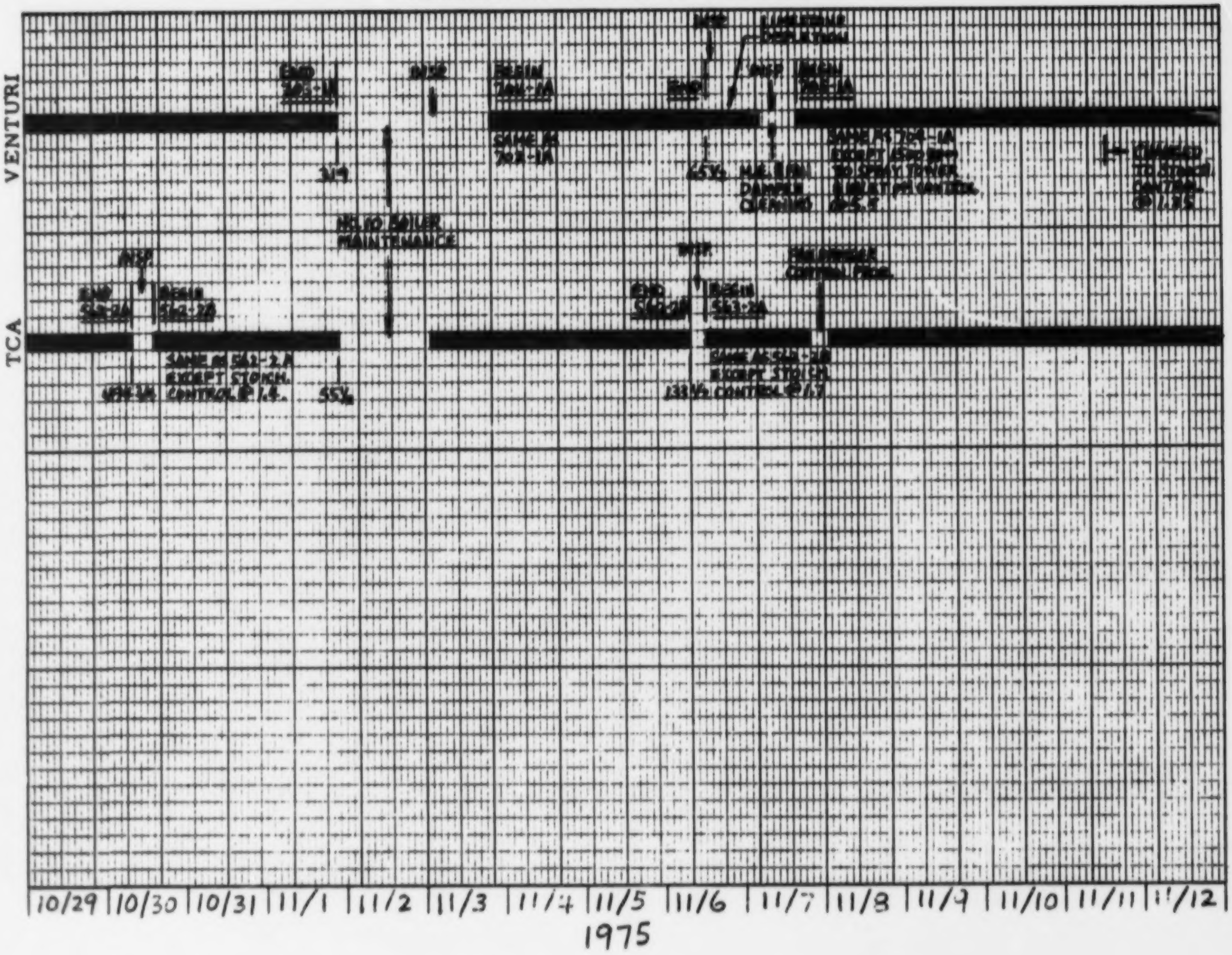

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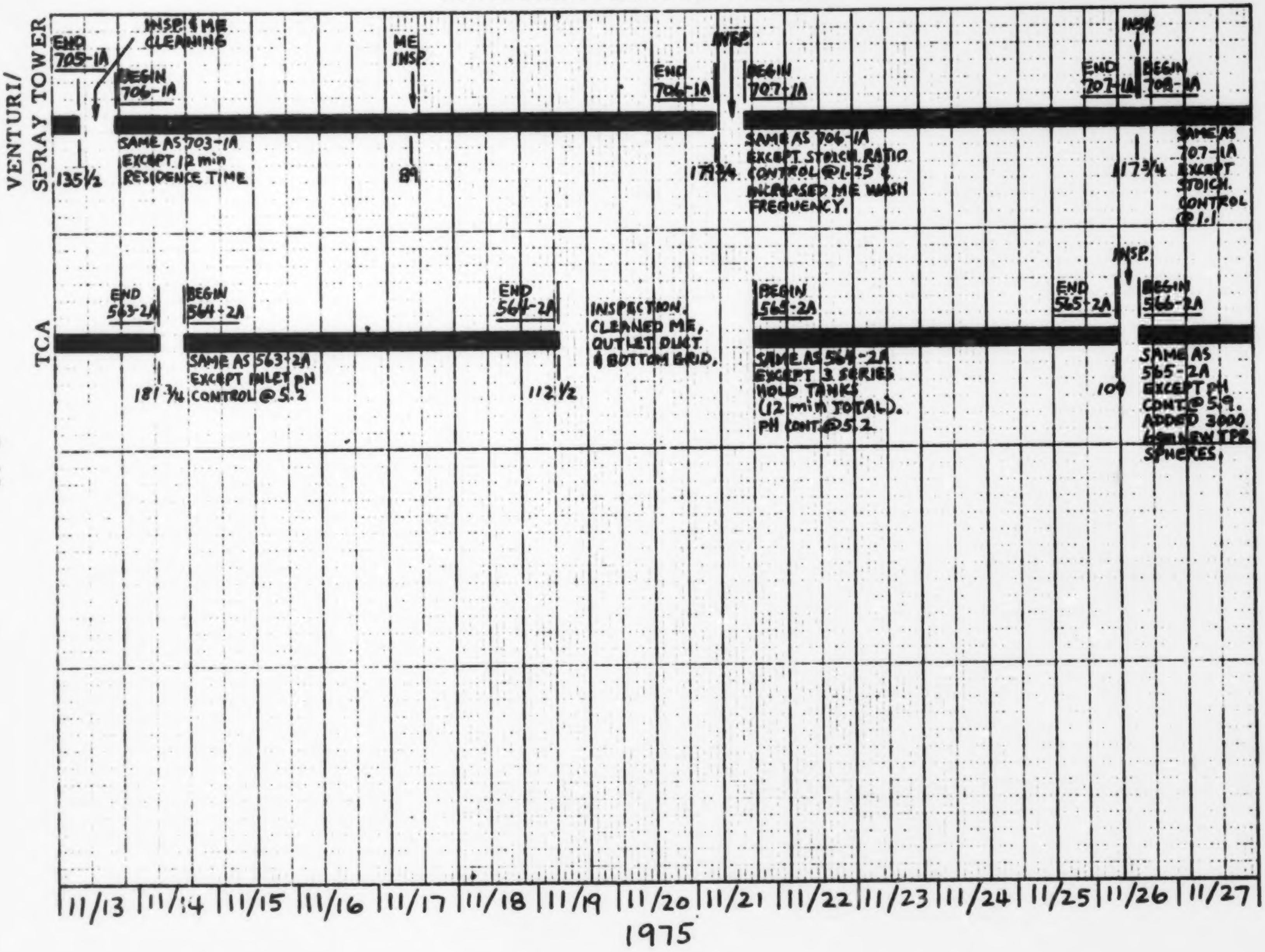

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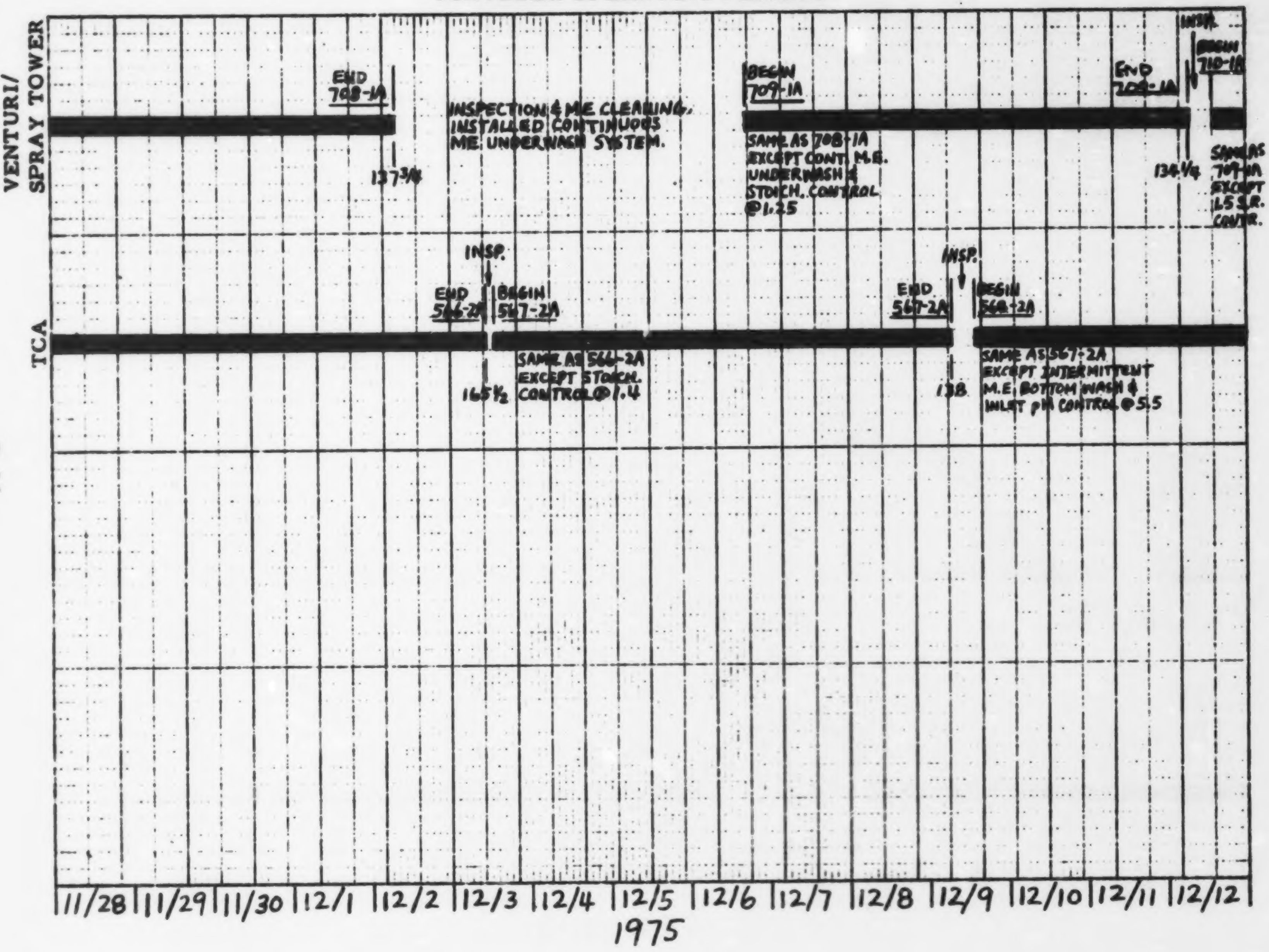

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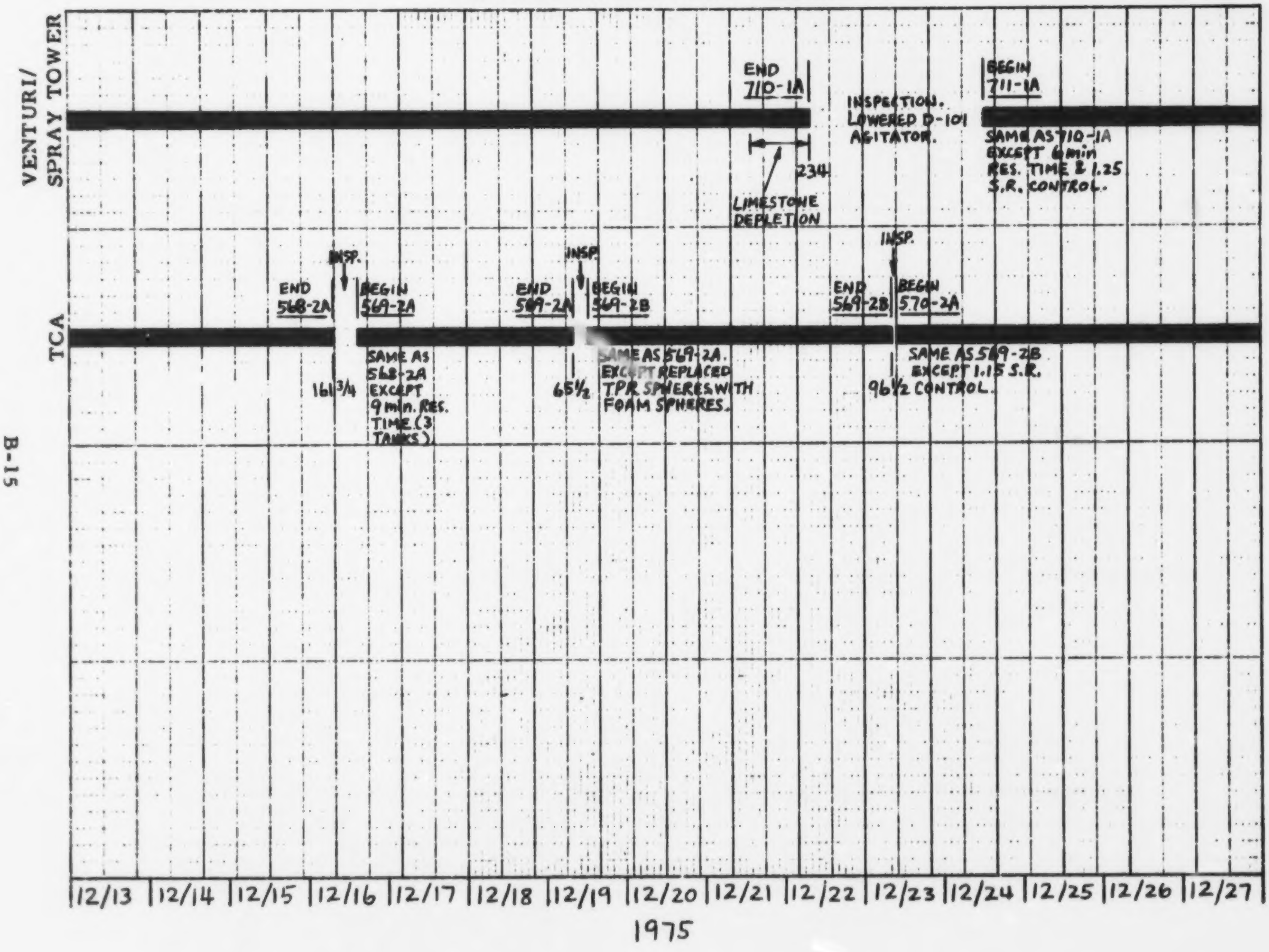

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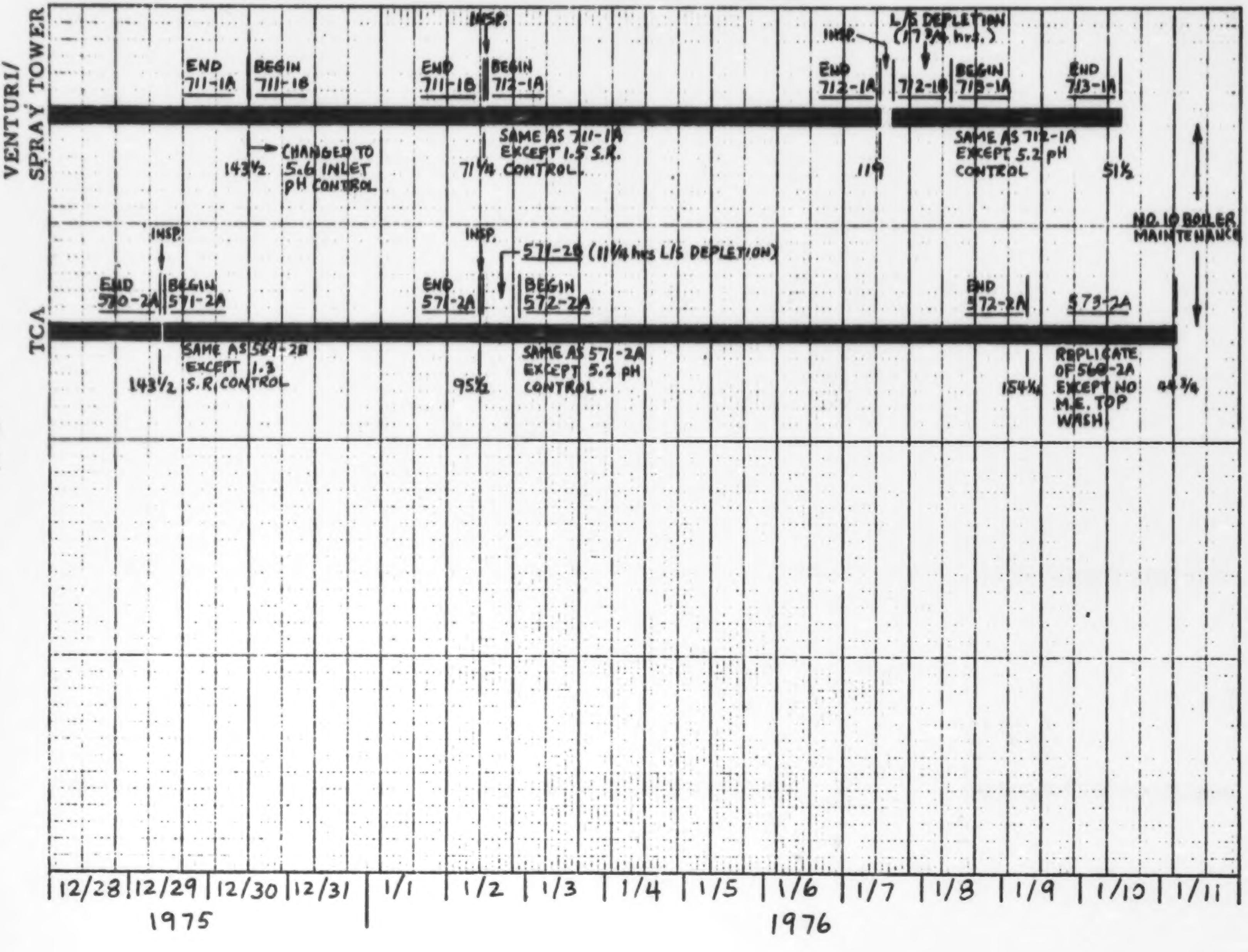

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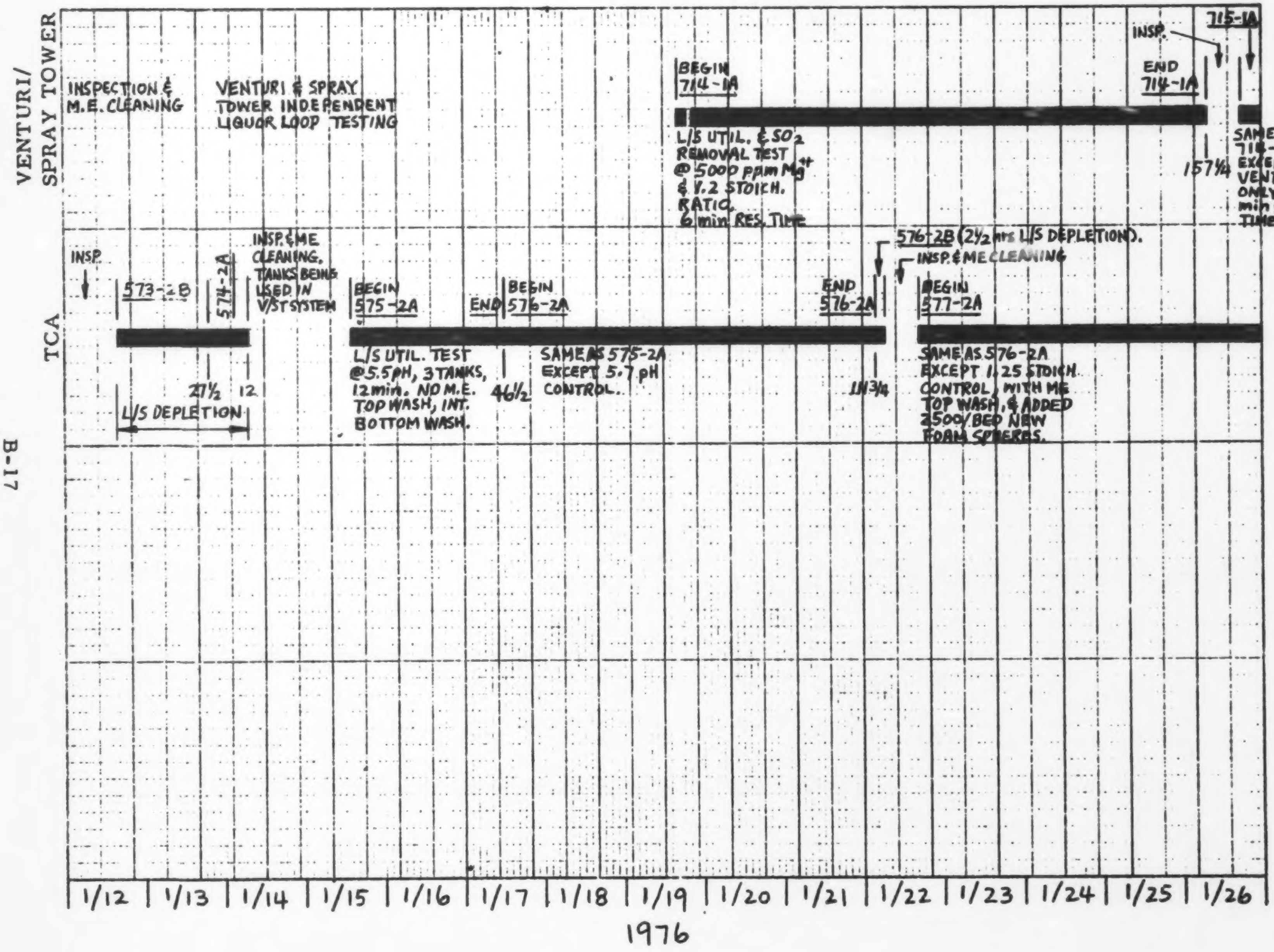
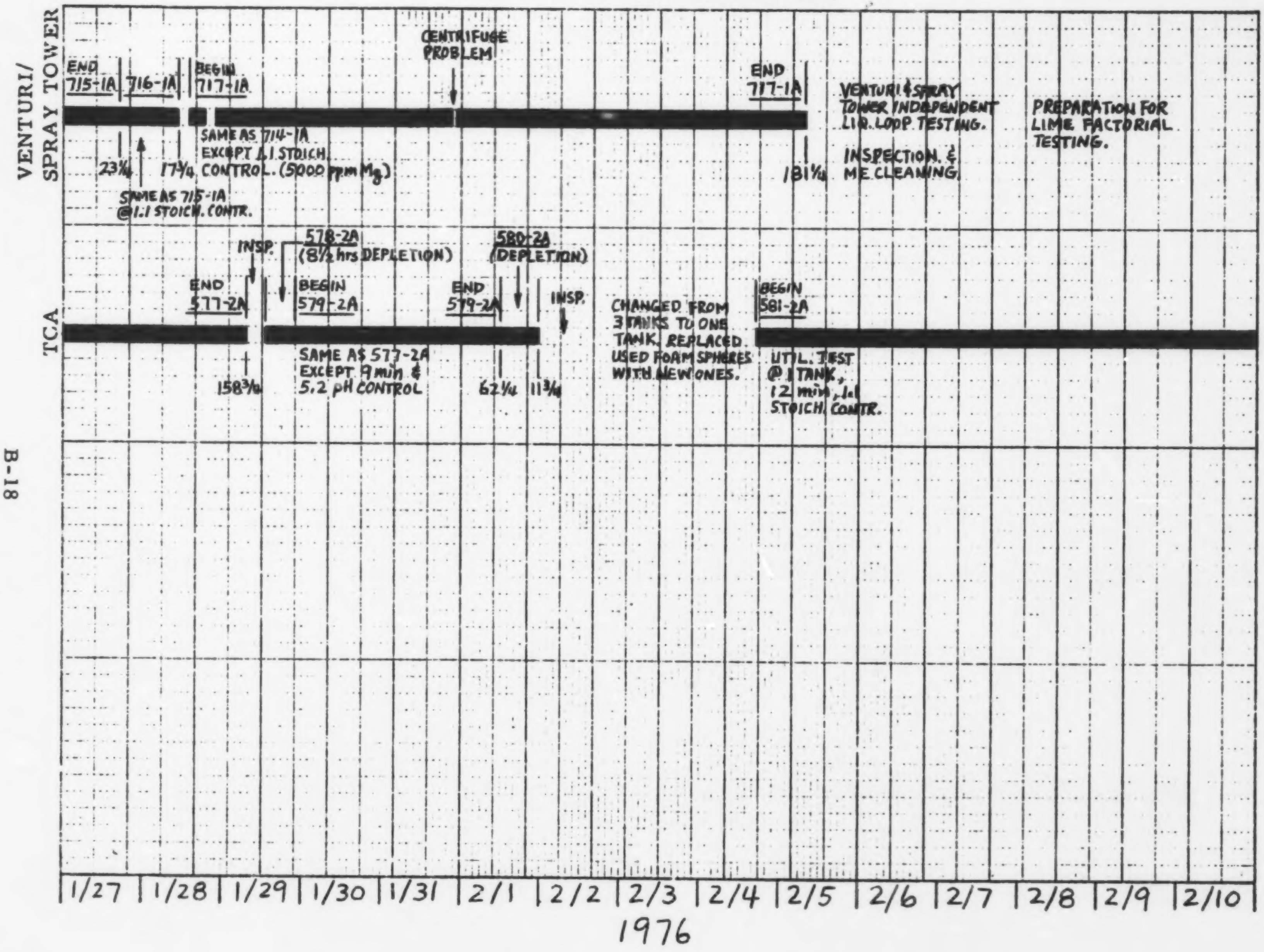
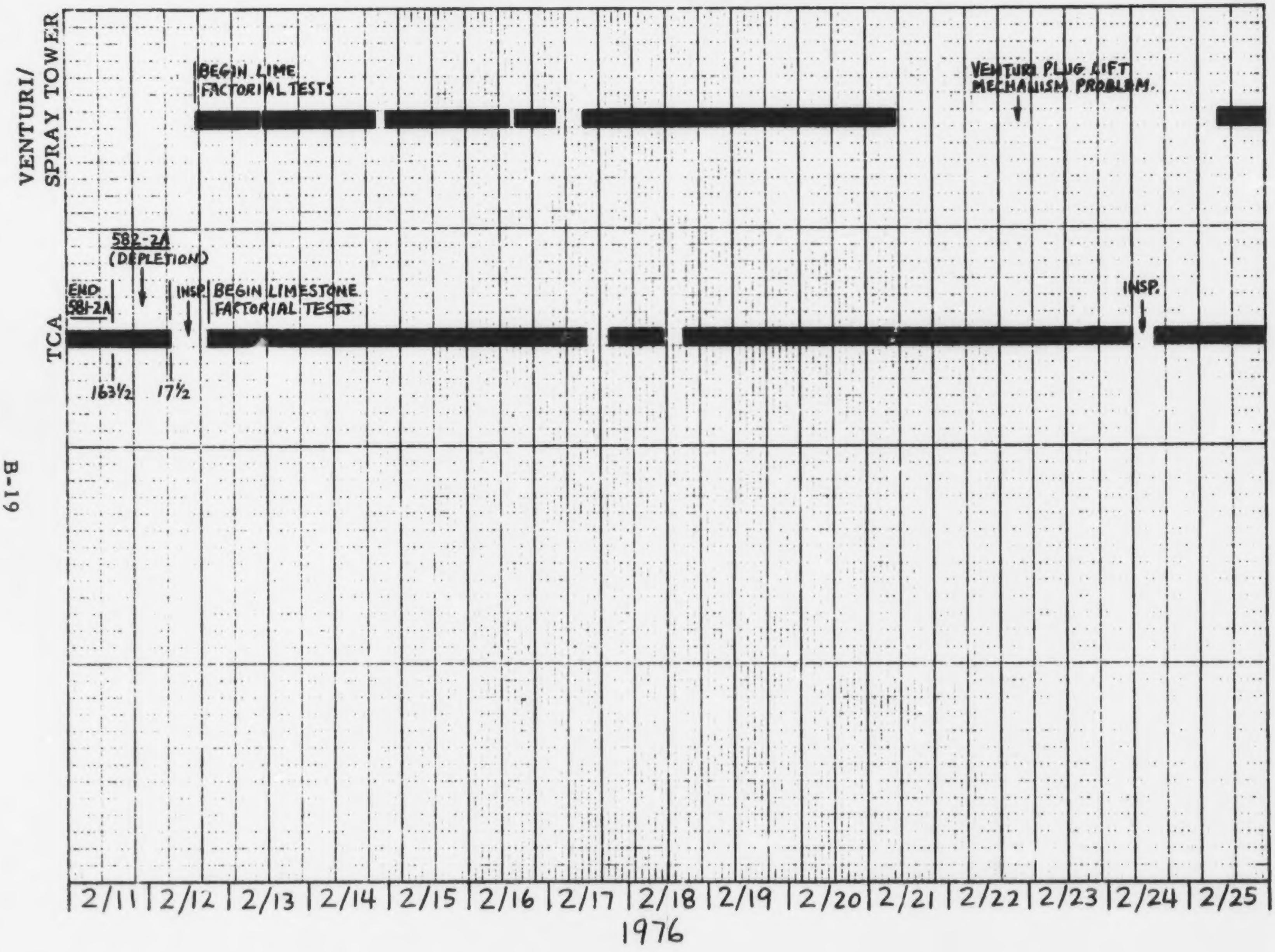


SCRUBBER OPERATING PERIODS



SCRUBBER OPERATING PERIODS



Appendix C

PROPERTIES OF RAW MATERIALS

The following is a summary of the properties of the raw materials used from June 1975 through mid-February 1976.

C.1 COAL

Supplier: Several

Type: Eastern (Southern Illinois) high sulfur.

Analysis:	9.4	to	12.4	wt % total moisture
	2.3	to	5.5	wt % sulfur
	0.03	to	0.27	wt % chloride
	14.7	to	27.9	wt % ash

Approximate Ash Analysis:

54 wt % SiO_2
23 wt % Al_2O_3
12 wt % Fe_2O_3
3 wt % CaO
1 wt % MgO
1 wt % SO_3
3 wt % K_2O
1 wt % Na_2O
3 wt % Ignition loss

Note: During isolated instances, Shawnee Unit No. 10 has burned low sulfur western coal of the following composition:

Supplier: Western Energy Company, Cow Creek, Montana

Type: Colstrip seam

Analysis(a):

26.8	wt % total moisture
0.95	wt % sulfur
0.1	wt % chloride
10.7	wt % ash

Approximate Ash Analysis: (None made)

C.2 LIMESTONE

Supplier: Fredonia Quarries, Fredonia, Kentucky

Type: Fredonia Valley White

Analysis:

95	wt % $CaCO_3$
1	wt % $MgCO_3$
4	wt % Inerts

Grind:

91	wt % less than 325 mesh
87	wt % less than 30 microns
86	wt % less than 27 microns
53	wt % less than 6 microns

C.3 LIME

Supplier: Linwood Stone Co., Davenport, Iowa (through 9/75)
Mississippi Lime Co., Alton, Illinois (after 9/75)

Type: Pebble lime, unslaked

Analysis:

97.0	wt % CaO total
95.5	wt % CaO available
0.28	wt % MgO
0.47	wt % Inerts

(a) Average values, from only two analyses.

C.4 MAGNESIUM OXIDE

Supplier: Basic Chemicals, Ft. St. Joe, Florida

Type: MAGOX PG (pollution grade)

Analysis:

97.6	wt % MgO
1.5	wt % CaO
0.5	wt % SiO_2
0.4	wt % R_2O_3

Appendix D

DATA BASE TABLES

SUMMARY OF VENTURI/SPRAY TOWER RUNS FROM JUNE 1975 TO MID-FEBRUARY 1976

RUN NUMBER	START DATE	END DATE	HRS ON STRM	LIME OR LS	ALK ADDN PT.	MGO	FLY ASH	GAS RATE ACFM	VEN LIQ RATE GPM	VEN L/G GAL/MACF	S.T. LIQ RATE GPM	S.T. L/G GAL/MACF	S.T. HEADER CONFIG	NO.OF HOLD TANKS	EFFLU RES TIME MIN	SOLID RECIRC WT.%	SOLIDS DISCH RANGE %	M.E. SYSTEM CONFIG	M.E. WASH B/T	DE-WATER SYSTEM	M.E. SYSTEM D.P.RANGE IN. WATER	VEN D.P. IN. H2O
625-1A	06/20/75	07/09/75	319	L	DNC	N	Y	30000	600	25	1200	50	1234	1	12.0	0.0	55-60	1-3P/0V	I/I	CL/F	0.15-0.30	9.0
626-1A	07/09/75	08/04/75	569	L	DNC	N	Y	35000	600	21	1400	50	1234	1	12.0	0.0	52-60	1-3P/0V	I/I	CL/F	0.37-0.40	9.0
627-1A	08/05/75	08/13/75	187	L	EHT	N	Y	35000	600	21	1400	50	1234	1	20.0	15.0	52-56	1-3P/0V	I/I	CL/F	0.37-0.42	9.0
628-1A	08/16/75	09/18/75	717	L	DNC	N	Y	*	600	*	*	*	1234	1	12.0	10.0	51-55	1-3P/0V	I/I	CL/F	0.00-0.45	9.0
628-1B	09/18/75	10/07/75	426	L	DNC	N	Y	*	600	*	1600	*	1234	1	12.0	9.0	52-56	1-3P/0V	I/I	CL/F	0.10-0.40	*
701-1A	10/09/75	10/12/75	73	LS	EHT	N	Y	35000	600	21	1600	57	1234	1	20.0	15.0	58-63	1-3P/0V	I/I	CL/F	0.35-0.70	9.0
702-1A	10/14/75	10/17/75	60	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	20.0	15.0	58-65	1-3P/0V	I/I	CB	0.35-0.60	9.0
703-1A	10/19/75	11/01/75	319	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	20.0	15.0	60-67	1-3P/0V	I/I	CB	0.30-0.40	9.0
704-1A	11/03/75	11/06/75	66	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	20.0	15.0	59-65	1-3P/0V	I/I	CB	0.35-0.76	9.0
705-1A	11/07/75	11/13/75	136	LS	EHT	N	Y	35000	600	21	1500	53	1234	1	20.0	15.0	53-66	1-3P/0V	I/I	CL/F	0.35-0.43	9.0
706-1A	11/13/75	11/19/75	180	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	12.0	15.0	54-75	1-3P/0V	I/I	CL/F	0.30-0.40	9.0
707-1A	11/21/75	11/26/75	118	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	12.0	15.0	58-73	1-3P/0V	I/I	CL/F	0.25-0.43	9.0
708-1A	11/26/75	12/02/75	138	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	12.0	15.0	59-65	1-3P/0V	I/I	CL/F	0.43-0.55	9.0
709-1A	12/06/75	12/12/75	134	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	12.0	15.0	61-65	1-3P/0V	C/I	CB	0.33-0.40	9.0
710-1A	12/12/75	12/22/75	234	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	6.0	15.0	57-63	1-3P/0V	C/I	CL/CB	0.33-0.40	9.0
711-1A	12/24/75	12/30/75	144	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	6.0	15.0	59-65	1-3P/0V	C/I	CB	0.35-0.40	9.0
711-1B	12/30/75	01/02/76	71	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	6.0	15.0	56-62	1-3P/0V	C/I	CB	0.33-0.30	9.0
712-1A	01/02/76	01/07/76	119	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	6.0	15.0	60-63	1-3P/0V	C/I	CB	0.36-0.40	9.0
712-1B	01/07/76	01/08/76	10	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	6.0	15.0		1-3P/0V	C/I	CB		9.0
713-1A	01/08/76	01/10/76	52	LS	EHT	N	Y	35000	600	21	1400	50	1234	1	6.0	15.0	59-60	1-3P/0V	C/I	CB	0.30-0.40	9.0
714-1A	01/19/76	01/26/76	157	LS	EHT	Y	Y	35000	600	21	1400	50	1234	1	6.0	15.0	57-62	1-3P/0V	I/I	CB	0.33-0.40	9.0
715-1A	01/26/76	01/27/76	23	LS	EHT	Y	Y	35000	600	21	0	0	1234	1	20.0	15.0	56-66	1-3P/0V	I/I	CB	0.35-0.40	9.0
716-1A	01/27/76	01/28/76	10	LS	EHT	Y	Y	35000	600	21	0	0	1234	1	20.0	15.0	70-73	1-3P/0V	I/I	CB	0.35-0.40	9.0
717-1A	01/28/76	02/05/76	181	LS	EHT	Y	Y	35000	600	21	1400	50	1234	1	6.0	15.0	53-59	1-3P/0V	I/I	CB	0.25-0.50	9.0

Note: Runs 628-1A and 628-1B were variable gas-load tests. See Appendices E and F for more operating details.

------------LIQUID ANALYSES AT SCRUBBER INLET------------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
625-1A	06/20/75	2300	8.25											7.5
	06/21/75	1500	7.50											7.1
	06/21/75	2300	7.90	1215	65	17	48	120	1225	1311	4001	93	3.6	7.6
	06/22/75	1500	7.45	1660	84	27	78	104	1130	2198	5301	91	4.7	7.5
	06/22/75	2300	8.90	1985	90	27	80	80	1354	2659	6235	110	2.0	7.8
	06/23/75	1500	9.40	3295	103	34	160	8	1030	4396	9026	90	18.4	7.5
	06/23/75	2300	8.60	2599	106	34	117	24	2258	3793	8931	181	-8.2	6.6
	06/24/75	1500	7.70	2930	126	26	157	40	1432	4254	8967	120	6.8	7.0
	06/25/75	1500	8.00	2724	143	37	131	80	1179	4041	8335	98	7.9	8.0
	06/25/75	2300	8.10	2879	149	39	108	40	1523	4077	8815	125	7.9	6.8
	06/30/75	1600	8.25	2975	113	49	120	24	996	4538	8815	96	8.4	9.2
	06/30/75	2300	7.90	2914	143	49	127	72	1067	4573	8945	90	5.9	8.5
	07/01/75	1500	8.20	3260	157	51	127	120	1468	4821	9996	123	6.5	7.7
	07/01/75	2300	8.00											7.9
	07/02/75	1500	8.15	3339	172	51	132	72	1619	4892	10277	135	6.9	7.0
	07/02/75	2300	8.45	3400	167	56	133	72	1625	5211	10664	136	3.5	6.3
	07/03/75	1500	8.45											7.1
	07/03/75	2300	8.00	4109	169	69	141	88	1654	6209	12394	139	6.5	6.1
	07/04/75	1500	8.15	4280	179	70	143	88	1342	5779	11881	117	17.8	7.5
	07/04/75	2300	8.25											8.4
	07/05/75	1500	9.10											6.8
	07/05/75	2300	8.10	3769	298	73	144	96	1442	5530	11262	122	11.2	8.0
	07/06/75	1500	8.10	3550	209	68	135	144	1205	6098	11409	101	0.0	7.3
	07/06/75	2300	8.10	3455	216	67	141	16	1420	5690	11005	118	3.2	8.3
	07/07/75	2300	8.75	3469	167	66	132	48	1171	5956	11039	190	-0.3	8.9
	07/08/75	1500	9.00	3240	126	63	114	128	917	5429	10017	80	1.3	9.4
	07/08/75	2300	8.30											8.8
626-1A	07/09/75	1500	8.10	3179	198	55	118	32	1196	5282	10060	99	3.1	9.3
	07/09/75	2300	8.15	2780	168	55	115	168	542	4892	6720	46	2.8	9.2
	07/10/75	1500	7.20											6.9
	07/10/75	2300	7.55	2719	196	55	115	80	1271	4963	9389	103	-7.8	9.7
	07/11/75	1500		2914	211	54	122	16	1457	5016	9790	117	-2.4	
	07/11/75	1501												8.6
	07/11/75	1502	9.19											8.7
	07/11/75	2300	7.90											6.8
	07/12/75	1500	9.00											9.9
	07/12/75	2300	8.00	2724	191	54	106	64	891	4928	8958	73	-1.6	9.7
	07/13/75	1500	8.10	2510	218	47	118	24	1077	4715	8709	85	-5.2	9.3
	07/13/75	2300	7.90	2425	202	63	151	152	633	4715	8341	51	-4.0	9.4
	07/14/75	1500	8.05	2589	217	49	126	32	1150	4768	8931	91	-4.5	8.8
	07/14/75	2300	7.90	2305	200	53	119	88	812	4609	8186	65	-9.0	9.4
	07/15/75	0700	8.00											9.5
	07/15/75	1400	8.20	2380	224	48	119	40	1028	4431	8270	80	-3.6	10.0
	07/15/75	2300	8.20	2500	237	46	123	32	966	4396	8300	76	3.0	8.9
	07/15/75	0700	9.15											9.0
	07/16/75	1500	8.30	2460	209	48	120	88	896	4467	8288	71	-1.2	8.5
	07/16/75	2300	8.30	2530	208	45	117	48	1109	4254	8311	88	2.7	9.1
	07/17/75	0700	8.30											9.5
	07/17/75	1500	8.15	2549	216	52	117	72	1573	4573	9152	122	-8.9	8.1
	07/17/75	2300	8.10	2495	225	48	122	80	1226	4360	8556	96	-1.5	8.4

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
626-1A	07/18/75	0700	8.05											8.9
	07/18/75	1500	8.10	2150	201	50	114	200	933	4219	7867	73	-11.3	8.7
	07/18/75	2300	8.15	2640	264	51	130	200	682	4290	8257	54	11.8	8.8
	07/19/75	0700	7.95											8.9
	07/19/75	1500	8.15	1965	212	50	117	176	707	4041	7268	54	-10.3	8.2
	07/19/75	2300	8.15	2630	238	48	119	312	1296	4360	9003	101	-1.2	6.4
	07/20/75	1500	8.05	2640	241	49	119	184	1278	4644	9155	100	-3.5	7.4
	07/20/75	2300		2689	248	55	125	216	1249	4396	8978	98	3.0	
	07/21/75	1500	7.90	2555	255	46	108	128	1382	4047	8523	106	4.7	7.7
	07/21/75	2300	8.10	2675	251	56	128	48	1411	4432	9001	110	2.7	8.4
	07/22/75	0500	7.75	2673	258	113	250	32	1316	4574	9222	102	5.4	
	07/23/75	1700	7.85											8.6
	07/23/75	2300	7.95	2975	270	58	130	56	1374	4503	9266	108	8.5	8.6
	07/24/75	0500	8.00	2750	260	110	250	48	1603	4609	9630	124	3.1	8.7
	07/24/75	1500	8.25	2513	216	110	250	24	1411	4325	8849	110	1.5	9.8
	07/24/75	2300	8.15	2525	217	52	48	48	1315	4184	8389	103	0.5	6.3
	07/25/75	0700	8.00	2605	231	110	250	32	1633	4134	8995	126	5.5	5.1
	07/25/75	1500	7.90	2680	264	54	123	80	1297	3936	8434	101	13.0	7.5
	07/25/75	2300	8.00											8.7
	07/26/75	0700	7.95	2261	224	101	250	40	1210	4006	8092	93	2.0	9.2
	07/26/75	1502	8.35											8.4
	07/26/75	2300	7.95	2540	191	56	118	45	2072	4224	9246	159	-10.5	9.0
	07/27/75	0700	8.20	2595	165	53	124	16	1888	4068	8909	149	-4.0	9.2
	07/27/75	1500	7.80	2345	189	55	115	72	951	3687	7414	76	8.9	9.6
	07/27/75	2300	8.10	2525	182	53	122	40	1768	4113	8303	101	2.0	6.3
	07/28/75	1500	8.25	2950	238	56	131	32	1678	4290	9575	147	6.8	5.4
	07/28/75	2300	7.75	2695	193	61	139	72	1529	4222	8911	122	2.5	4.6
	07/29/75	0700	7.95	2970	211	65	142	104	1425	4892	9809	115	1.0	7.2
	07/29/75	1500	8.00	3679	221	69	132	112	1443	5070	10926	122	19.4	7.5
	07/30/75	1500	7.95	3570	215	65	132	40	1263	5105	10394	106	15.3	8.0
	07/30/75	2300	8.15	3285	221	68	135	16	1477	5779	10961	121	-3.0	7.6
	07/31/75	1502	8.05											8.5
	07/31/75	2300		4119	265	75	138	32	1458	6062	12149	123	13.7	
	07/31/75	2302	7.85											7.7
	08/01/75	1500	7.95	3315	243	74	133	88	1343	5672	10868	110	1.0	6.7
	08/01/75	2300	7.90											5.8
	08/02/75	0700	8.25	3919	246	78	142	112	1316	6275	12088	111	7.0	5.5
	08/02/75	1500	8.05											6.8
	08/02/75	2300	8.05	3300	229	81	145	24	1456	6346	11581	119	-10.0	
	08/02/75	2302												
	08/03/75	0700	7.90	3479	253	82	147	88	1312	6417	11778	108	-4.3	7.8
	08/03/75	1500	7.70	4000	264	21	147	16	1593	6452	12463	132	4.7	4.9
	08/03/75	2300	7.95	3445	255	86	158	32	1615	6523	12114	131	-8.8	5.1
	08/04/75	0700	7.90	3265	245	81	159	24	1526	6204	11507	123	-8.6	6.1
627-1A	08/05/75	1500	7.80	3940	249	78	156	56	1094	6311	11883	93	9.9	9.3
	08/05/75	2300	7.10											9.8
	08/06/75	1500	7.80	2934	190	74	133	16	1057	4716	9120	87	7.9	5.7
	08/06/75	2300	8.10	2989	99	74	140	24	1199	4690	9205	103	4.0	5.8
	08/07/75	1500	8.05											5.8
	08/07/75	2300	8.25	3186	51	83	148	24	1094	4963	9549	97	4.2	5.3

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
627-1A	08/08/75	0700	8.15											5.4
	08/08/75	1215	7.95	3054	54	74	175	48	1007	5318	9730	89	-4.6	9.7
	08/08/75	2300	8.25											11.6
	08/09/75	0700	8.15	3660	53	76	19	72	610	5140	9630	56	16.5	
	08/09/75	1500	8.05											
	08/09/75	2300	8.10	2468	75	78	160	72	403	4609	7865	35	-2.1	
	08/10/75	0700	8.15	2489	77	63	31	96	518	4325	7590	45	-1.2	9.3
	08/10/75	1500	8.20	2164	83	74	188	8	451	4290	7258	39	-6.3	9.2
	08/10/75	2300		2124	85	74	164	208	181	3545	6381	16	9.5	
	08/11/75	1500	8.10	2265	89	73	191	56	557	3935	6986	47	-3.8	6.8
	08/11/75	2300	8.00	2140	123	76	183	104	887	3368	6661	74	5.8	8.5
	08/12/75	1500	8.10	2130	110	80	195	24	718	3722	7039	60	4.9	7.8
	08/12/75	2300	7.75											8.7
	08/13/75	0700		2076	102	139	360	48	537	3510	6771	45	12.4	
	08/13/75	1100	8.05	2056	124	147	391	40	1758	3446	7962	136	-4.3	4.1
628-1A	08/16/75	1500	7.80											
	08/16/75	2300	8.00	2675	122	55	155	56	1644	3793	8460	135	4.2	
	08/17/75	0700	6.95	2595	127	73	169	104	1395	3829	8202	114	2.3	
	08/17/75	1500	7.10	2445	115	70	175	96	1420	3758	8083	116	0.8	
	08/17/75	2300	6.90	2764	157	72	163	72	1589	3616	8433	129	13.5	
	08/18/75	0700												
	08/18/75	1500	6.30	2255	135	72	164	328	1215	3758	7923	98	-6.5	
	08/18/75	2300	6.65	2859	171	78	184	80	1451	3793	8616	118	15.6	
	08/19/75	0700												
	08/19/75	1500	7.85	2070	170	69	159	80	1236	3793	7577	96	-8.3	
	08/19/75	2300	7.65											
	08/20/75	0700												
	08/20/75	1500	7.15	2250	173	67	174	104	1361	4077	8206	106	-9.0	
	08/20/75	2300	7.50	2533	293	74	159	72	1189	4254	8461	94	2.5	
	08/21/75	1500		2100	177	72	157	24	1486	3970	7986	114	-13.5	
	08/21/75	2300	7.35											
	08/22/75	0700	7.30	2549	241	75	163	24	1672	4201	8965	128	1.6	
	08/22/75	2300	7.95											
	08/23/75	0700	8.10	2115	252	68	154	8	1086	3864	7547	81	1.0	
	08/23/75	1500	7.80											
	08/23/75	2300	7.75	2390	268	79	153	24	1097	4254	8256	83	3.3	
	08/24/75	0700	7.80	2435	254	68	143	16	1856	3900	8672	138	0.0	
	08/24/75	1500	7.65	2310	296	68	147	96	1031	4006	7954	77	6.5	
	08/24/75	2300	7.80	2060	289	72	144	18	771	4006	7433	57	1.6	
	08/25/75	0700												
	08/25/75	2300	7.75	2125	211	34	130	40	1360	3935	7835	103	-9.4	
	08/26/75	0700												
	08/26/75	1500	7.75	2215	305	66	149	112	1341	3510	7698	97	8.9	
	08/26/75	2300	8.05											
	08/27/75	0700												
	08/27/75	1500	7.90	2000	301	62	155	192	994	1455	5159	71	49.3	
	08/27/75	2300	8.25	2075	312	72	156	8	1404	3580	7607	99	4.3	
	08/28/75	1500	7.70	2010	312	63	125	112	1444	3510	7576	101	0.0	
	08/28/75	2300	7.80											
	08/29/75	0700	7.60	1940	309	57	118	72	1736	3332	7563	118	-3.3	

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RLA NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
628-1A	08/29/75	2300	7.75											
	08/30/75	0700	7.85	1725	285	59	121	168	1333	3196	6882	91	-5.8	
	08/30/75	1500	7.15											
	08/30/75	2300	6.80	1895	327	68	155	24	1662	3332	7463	112	-0.6	
	08/31/75	0700	6.70	1700	289	53	113	104	1666	3463	7328	111	-17.1	
	08/31/75	1500	6.70	2150	347	66	148	32	1646	3403	7779	119	0.1	
	09/01/75	2300	7.25	1870	377	65	154	16	1661	3297	7394	111	-0.5	
	09/02/75	0700												
	09/02/75	1500	7.65	1830	312	61	140	24	1645	3190	7202	111	-1.3	
	09/02/75	2300	7.85											
	09/03/75	0700	7.85	2000	364	67	154	56	1624	3261	7526	109	6.9	
	09/04/75	2300	7.15	1775	319	66	154	304	1488	3053	7149	100	-3.2	
	09/05/75	0700	7.95	1640	314	64	160	48	1527	2943	6736	100	0.5	
	09/05/75	2300	7.65											
	09/06/75	0700	7.45	1935	318	64	150	48	2073	2871	7509	139	4.9	
	09/06/75	1500	7.70											
	09/06/75	2300	7.95	1520	281	60	158	80	1317	3084	6500	87	-10.2	
	09/07/75	0700	7.30	1930	313	56	132	72	2189	3049	7741	145	-4.3	
	09/07/75	1500	7.45	1115	319	52	120	16	2284	1595	5501	122	-6.6	
	09/07/75	2300	7.75	1610	289	55	136	88	1634	3155	6947	109	-15.6	
	09/08/75	0700												
	09/08/75	1500	7.45	1595	337	56	133	4	1347	2875	6347	87	3.5	
	09/08/75	2300	7.95	1155	272	54	130	168	863	2871	5563	56	-18.8	
	09/09/75	0700												
	09/09/75	2300	7.95											
	09/10/75	0700												
	09/10/75	1500	7.10	1760	341	52	129	36	1166	2694	5778	71	0.3	
	09/10/75	2300	8.55	1475	292	53	122	56	886	2694	5578	59	7.0	
	09/11/75	1500	7.75	1250	329	51	129	16	749	2694	5218	46	3.1	
	09/11/75	2300	7.45											
	09/12/75	0700	7.15	1405	304	49	125	72	934	2588	5477	60	6.2	
	09/12/75	2300	7.75											
	09/13/75	0700	7.60	2285	253	63	118	48	2330	3084	8181	167	2.8	
	09/13/75	1500	7.95											
	09/13/75	2300	7.90	1805	312	53	127	56	1306	3261	6920	89	0.6	
	09/14/75	0700	7.95	1915	311	58	122	48	1513	3084	7051	104	5.6	
	09/14/75	1500	7.95	2255	302	57	115	72	2350	3049	8200	164	4.3	
	09/14/75	2300	7.90	1695	330	56	132	48	1192	2836	6289	79	9.8	
	09/15/75	1500	8.00	1375	274	54	123	64	813	3013	5716	54	-7.5	
	09/15/75	2300	7.75	1955	364	57	148	48	1069	2942	6483	72	17.3	
	09/16/75	0700												
	09/16/75	1200												
	09/16/75	1500	7.50	1510	273	53	114	60	1265	2907	6222	84	-7.1	
	09/16/75	2300	8.30											
	09/17/75	0700												
	09/17/75	1500	7.95	1650	249	57	130	136	1650	3049	6947	114	-14.7	
	09/17/75	2300	7.70	1755	311	51	115	64	1352	3120	6768	91	0.5	
628-1B	09/18/75	1500	7.75	1730	211	50	124	48	1948	3013	7124	135	-16.2	
	09/18/75	2300	6.45											
	09/19/75	0700	6.90	2105	315	63	126	16	1671	3442	7738	117	3.4	

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
628-19	09/19/75	2300	7.50											
	09/20/75	0700	7.95	1820	321	61	123	8	1075	3439	6847	74	2.8	
	09/20/75	1500	8.15											
	09/20/75	2300	7.10	1755	291	60	125	56	973	3403	6663	68	-0.3	
	09/21/75	0700	8.25	1890	302	62	126	24	1200	3350	6954	84	4.0	
	09/21/75	1500	8.10	1790	303	61	125	72	938	3403	6692	65	2.3	
	09/21/75	2300	8.05	1925	299	61	121	72	1444	3297	7219	100	1.2	
	09/22/75	1500	7.35	1880	279	61	134	40	1561	3226	7261	107	0.8	
	09/22/75	2300	7.43	1825	277	60	122	48	1217	3226	6775	96	1.7	
	09/23/75	0700	7.45	1785	274	60	111	56	1191	3226	6703	93	0.5	
	09/23/75	1500	7.05	1925	271	59	125	88	1613	3368	7449	113	-5.4	
	09/23/75	2300	8.00											
	09/24/75	1500	7.20	2055	297	61	140	72	1707	3474	7806	119	-1.6	
	09/24/75	2300		2080	295	82	124	8	1619	3442	7650	114	2.8	
	09/26/75	2300	7.65											
	09/27/75	0700	8.05	1863	243	55	109	16	1210	3616	7112	87	-0.8	
	09/27/75	1500	8.05											
	09/27/75	2300		2224	289	60	125	64	1133	3794	7689	84	5.9	
	09/27/75	2302	7.50											
	09/28/75	0700	8.10	2039	273	59	118	96	908	3722	7165	69	-0.2	
	09/28/75	1500	8.30	2645	265	59	130	72	1078	3829	8078	84	17.2	
	09/28/75	2300	7.90	2325	236	63	134	40	1222	3970	7990	93	2.3	
	09/29/75	1500		2759	256	64	131	40	1940	5070	10260	148	-11.8	
	09/29/75	1502	7.95											
	09/29/75	2300		2869	256	66	132	32	1652	4609	9616	129	3.1	
	09/29/75	2302	7.55											
	09/30/75	0700	8.30	2785	250	68	131	32	1498	4609	9363	116	2.5	
	09/30/75	1500	8.00	2810	227	68	106	24	1260	4502	8997	101	6.5	
	09/30/75	2300	8.15											
	10/01/75	1500	9.10	3115	250	70	133	32	1094	4892	9566	89	11.5	
	10/01/75	1501	8.10	3220	256	70	125	24	1072	4892	9663	87	14.5	
	10/01/75	2300	8.15	2530	262	68	122	46	944	4750	8724	73	-0.6	
	10/01/75	2301	8.15	2505	265	70	120	46	965	4715	8668	75	-0.9	
	10/02/75	1500	8.10	2700	293	68	125	0	1116	4715	9017	86	5.3	
	10/02/75	1501	8.10											
			8.10	2775	294	67	128	16	1076	4750	9106	84	7.2	
	10/02/75	2300	8.10											
	10/02/75	2301	9.10											
	10/03/75	2300	8.40											
	10/03/75	2301	9.40											
	10/04/75	0700	9.10	3354	381	72	125	40	1530	5548	11050	118	7.7	
	10/04/75	0701		3370	382	72	125	32	1570	5530	11051	121	8.0	
	10/04/75	1500	7.65											
	10/04/75	1501	7.65											
	10/04/75	2300	9.20	2410	322	65	115	24	954	4857	8747	71	-3.2	
	10/05/75	0700	7.95	2535	352	62	113	56	978	4431	8527	73	8.9	
	10/05/75	1500	7.65	2560	348	64	116	24	1005	4857	8974	75	2.2	
	10/05/75	1501	7.65											
	10/05/75	1506												
	10/05/75	1511												

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
628-1B	10/05/75	2300	8.00	2270	292	64	119	144	850	4538	8277	64	-4.3	
	10/05/75	2301	8.00	2125	279	59	117	144	850	4753	8324	63	-15.4	
	10/06/75	0709												
	10/06/75	1500	7.75	2460	361	66	127	40	833	4786	8673	62	3.3	
	10/06/75	1501	7.75	2445	355	65	131	56	793	4786	8631	59	2.9	
	10/06/75	2300	7.85	2200	330	63	122	60	835	4006	7636	61	7.3	
	10/06/75	2306												
	10/06/75	2308												
	10/06/75	2311												
	10/07/75	0700	7.35	2210	365	64	118	16	828	4431	8032	59	2.4	9.8
	10/07/75	0701	7.35	2240	371	64	115	32	798	4467	8087	57	3.1	9.8
701-1A	10/09/75	2300	5.70											7.5
	10/09/75	2301	5.70											7.5
	10/09/75	2306												
	10/10/75	0700	5.95	2604	365	58	99	24	1419	4821	9400	104	-0.4	7.5
	10/10/75	0706												
	10/10/75	2300	5.85											9.0
	10/10/75	2301	5.85											9.0
	10/10/75	2308												
	10/11/75	0700	5.80	2230	396	73	110	64	585	4892	8350	42	-1.3	8.4
	10/11/75	0701	5.80	2280	392	70	105	56	596	4857	8359	43	8.7	8.4
	10/11/75	1500	5.85											9.0
	10/11/75	1501	5.85											9.0
	10/11/75	2300	5.90	2579	465	67	109	72	467	4928	8687	34	12.8	9.4
	10/11/75	2301	5.90	2564	457	67	108	64	455	4928	8643	33	12.4	9.4
	10/12/75	0700	5.85	2135	448	74	115	16	329	4921	8038	23	2.3	9.2
	10/12/75	0701	5.85	2150	451	75	116	6	348	4921	8069	24	2.9	9.2
	10/12/75	1500	5.90	1985	436	70	113	16	370	5034	8024	25	-6.5	9.4
	10/12/75	1501	5.30	1940	454	68	107	32	371	4999	7971	25	-6.9	9.4
	10/12/75	1511												
	10/12/75	2311												
702-1A	10/14/75	2300	5.60											9.2
	10/14/75	2301	5.60											9.2
	10/15/75	0709												
	10/15/75	1500	5.75	1710	447	54	104	80	278	4360	7033	18	-2.9	11.7
	10/15/75	1501		1630	484	55	105	88	296	4396	7054	18	-4.9	
	10/15/75	2300	5.95	2015	619	54	74	32	451	4502	7747	28	11.9	9.7
	10/15/75	2301	5.95	2035	634	54	76	32	441	4467	7739	27	13.9	9.7
	10/15/75	2311												
	10/15/75	2312												
	10/16/75	1500	5.80	2110	469	53	76	88	490	5140	8426	33	-6.3	9.5
	10/16/75	1501	5.80	2080	451	54	75	60	520	5176	8436	35	-9.4	9.5
	10/16/75	1508												
	10/16/75	2300	5.85											9.4
	10/16/75	2301	5.85											9.4
	10/17/75	0500	5.80	2025	600	82	106	32	403	5105	8353	25	2.2	10.1
703-1A	10/19/75	1100	5.30											6.0
	10/19/75	1500	5.10	3044	841	57	127	192	1928	5247	11436	121	14.9	5.5
	10/19/75	1900	5.25											6.8
	10/19/75	2300	5.10											7.5

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
703-1A	10/20/75	0300	5.10											7.4
	10/20/75	1500		2839	623	84	106	216	2084	5353	11296	137	-0.5	
	10/21/75	1500	5.30	2859	219	95	170	56	1667	5708	11414	104	9.3	4.5
	10/21/75	1900	5.30											5.8
	10/21/75	2300	5.10											6.0
	10/22/75	0300	5.25											7.9
	10/22/75	0600	5.20											8.1
	10/22/75	1500	5.05											7.4
	10/22/75	1900	5.25											7.0
	10/22/75	2300	5.20											7.0
	10/23/75	0300	5.15											6.9
	10/23/75	0700	5.20											7.6
	10/23/75	1100	5.20											6.9
	10/23/75	1500	5.25	2665	695	45	96	112	1532	5353	10498	98	4.6	5.7
	10/23/75	1900	5.15											5.0
	10/23/75	2300	5.20											5.4
	10/24/75	0300	5.35											5.8
	10/24/75	0700	5.15											5.4
	10/24/75	1100	5.15											5.2
	10/24/75	1500	5.30	2889	454	82	93	112	1623	5743	10996	117	-5.9	5.2
	10/24/75	1900	5.20											5.4
	10/24/75	2300	5.15											5.7
	10/25/75	0300												6.3
	10/25/75	0700	5.32	2739	536	77	90	104	1574	6027	11147	108	-10.2	6.2
	10/25/75	1100	5.19											5.5
	10/25/75	1500	5.12	2920	535	93	106	320	1450	5991	11415	102	-5.4	4.8
	10/25/75	1900	5.16											4.7
	10/25/75	2300	5.30											6.2
	10/26/75	0302	5.30											6.8
	10/26/75	0700	5.25	2950	539	90	110	64	1459	6736	11948	103	-11.9	6.9
	10/26/75	1100	5.28											6.7
	10/26/75	1500	5.21	3039	544	100	113	120	1383	6878	12177	98	-10.9	6.8
	10/26/75	1900	5.24											7.3
	10/26/75	2300	5.30											8.5
	10/27/75	0300	5.32											8.4
	10/27/75	0700	5.32	3419	673	104	113	16	1346	6771	12442	95	6.0	8.6
	10/27/75	1100	5.22											7.6
	10/27/75	1500	5.23	3100	600	104	109	54	988	6594	11559	70	1.5	7.3
	10/27/75	1900	5.35											7.0
	10/27/75	2300	5.25											6.6
	10/28/75	0300	5.13											6.5
	10/28/75	0700	5.31	3149	697	113	121	48	1030	6700	11858	71	4.9	8.3
	10/28/75	1100	5.20											7.3
	10/28/75	1500	5.12	2995	623	117	122	104	1017	6523	11501	71	0.6	6.5
	10/28/75	1900	5.25											6.3
	10/28/75	2300	5.03											5.4
	10/29/75	0300	5.07											6.0
	10/29/75	0700	5.13	3609	614	105	128	56	1542	6633	12687	112	7.5	6.7
	10/29/75	1100	5.12											6.8
	10/29/75	1500	5.27											7.4

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
703-1A	10/29/75	1900	5.13											6.9
	10/29/75	2300	5.25											7.0
	10/30/75	0300	5.07											7.0
	10/30/75	0700	5.17	2869	608	100	118	104	1146	5850	10795	79	4.5	7.5
	10/30/75	1100	5.32											7.7
	10/30/75	1500	5.15	3314	666	92	117	216	1133	6062	11600	80	12.0	6.1
	10/30/75	1900	5.24											6.5
	10/30/75	2300	5.24											6.6
	10/31/75	0700		3349	429	94	141	48	1965	6559	12585	147	-8.1	
	10/31/75	1500		3135	662	102	125	64	1753	6452	12293	119	-0.7	
	11/01/75	0300	5.10											8.2
	11/01/75	0700	5.18	2970	669	97	115	56	1407	6552	11866	95	-2.4	7.5
	11/01/75	1100	5.32											7.0
	11/01/75	1500	5.08	3039	697	103	127	184	1258	6417	11825	85	2.3	6.3
	11/01/75	1900	5.13											5.6
704-1A	11/03/75	2300	5.55											8.1
	11/04/75	0300	5.55											7.8
	11/04/75	0700	5.58	3310	698	105	125	88	1535	6736	12597	106	2.7	8.6
	11/04/75	1100	5.60											9.2
	11/04/75	1500	5.66	3395	759	114	127	112	1375	6594	12476	94	9.4	9.3
	11/04/75	1900	5.69											9.5
	11/04/75	2300	5.82											10.7
	11/04/75	2307												
	11/05/75	0300	5.84											13.1
	11/05/75	0700	5.77	3215	617	113	121	104	479	6391	11030	35	12.2	12.8
	11/05/75	1100	5.86											12.0
	11/05/75	1500	5.94	2410	737	102	116	72	298	5850	9585	19	8.1	12.3
	11/05/75	1900	5.89											11.6
	11/05/75	2300	5.74											12.6
	11/06/75	0300	5.95											14.2
	11/06/75	0700	5.99	1935	1053	108	112	160	240	5389	8997	12	15.6	13.9
	11/06/75	1100	5.91											12.5
	11/06/75	1500		2025	773	91	112	104	422	5070	8597	24	10.0	
	11/06/75	1530	5.86											12.1
	11/06/75	1900	5.79											9.9
	11/06/75	2300	5.65											8.7
	11/07/75	0500	5.81	1880	527	97	119	56	787	4928	8393	49	-8.6	9.7
705-1A	11/07/75	1900	5.39											7.5
	11/07/75	2300	5.42											7.7
	11/08/75	0300	5.46											8.1
	11/08/75	0700	5.67	2185	491	93	103	96	1085	4538	8591	72	1.7	8.8
	11/08/75	1100	5.71											9.0
	11/08/75	1500	5.79	1915	623	81	107	96	972	4077	7871	58	10.1	8.6
	11/08/75	1900	5.70											9.4
	11/08/75	2300	5.71											8.5
	11/09/75	0300	5.71											8.5
	11/09/75	0700	5.64	2165	497	85	101	48	882	4077	7855	59	13.3	9.2
	11/09/75	1100	5.63											9.0
	11/09/75	1500	5.78	1685	551	79	105	72	826	4041	7359	49	1.9	8.8
	11/09/75	1900	5.75											8.8

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
705-1A	11/09/75	2300	5.71											9.0
	11/10/75	0300	5.69											9.2
	11/10/75	0700	5.55	1325	641	87	104	60	631	3857	6705	32	1.5	9.4
	11/10/75	1100	6.08											9.3
	11/10/75	1500	5.92	1202	627	73	103	136	514	3864	6519	25	-4.9	8.9
	11/10/75	1900	5.77											9.7
	11/10/75	2300	5.69											10.2
	11/11/75	0300	5.69											10.4
	11/11/75	0700	5.65	1145	642	68	103	56	528	3580	6122	25	1.9	10.8
	11/11/75	1100	5.69											10.9
	11/11/75	1500	5.85	1030	657	72	108	88	476	3616	6047	21	-2.5	10.8
	11/11/75	1900	6.05											10.5
	11/11/75	2300	5.95											11.1
	11/12/75	0300	6.05											11.6
	11/12/75	0700	6.00	1000	606	60	103	80	548	3368	5765	25	-3.2	11.3
	11/12/75	1100												10.1
	11/12/75	1500	5.75	1130	554	60	102	104	728	3190	5868	36	-0.5	8.7
	11/12/75	1900	5.70											8.7
	11/12/75	2300	5.50											8.8
	11/13/75	0300	5.95											8.2
	11/13/75	0700	5.35	1425	602	66	102	80	1111	4112	7498	58	-11.9	7.8
706-1A	11/13/75	2300	5.20											8.0
	11/14/75	0300	5.10											8.5
	11/14/75	0700	5.60	2200	582	67	94	24	2653	4290	9910	158	-8.5	8.8
	11/14/75	1100												9.4
	11/14/75	1500	5.65	1935	664	52	131	40	2549	4219	9590	139	-10.4	9.2
	11/14/75	1900	5.65											10.6
	11/14/75	2300	5.90											10.7
	11/15/75	0300	5.65											9.9
	11/15/75	0700	5.70	1520	639	71	107	72	1390	4130	7929	72	-9.7	9.5
	11/15/75	0707												
	11/15/75	0710												
	11/15/75	1100	5.68											9.6
	11/15/75	1500	5.55	1500	639	68	109	64	1711	4006	8097	87	-12.8	8.0
	11/15/75	1900	5.30											6.6
	11/15/75	2300	5.60											7.7
	11/16/75	0300	5.55											8.7
	11/16/75	0700	5.40	1785	628	70	115	256	2527	3864	9245	135	-14.5	7.8
	11/16/75	0707												
	11/16/75	1100	5.45											9.1
	11/16/75	1500	5.10	1480	553	51	147	424	2378	3616	8649	122	-29.3	6.8
	11/16/75	1900	5.35											8.0
	11/16/75	2300	5.35											7.8
	11/17/75	0300	5.25											7.5
	11/17/75	0700	5.30	1480	654	63	103	240	2664	3545	8749	128	-21.4	7.2
	11/17/75	1100	5.20											7.5
	11/17/75	1500	5.25	1680	630	61	108	376	2555	3687	9097	133	-18.1	6.6
	11/17/75	1900	5.20											6.5
	11/17/75	2300	5.35											6.8
	11/18/75	0300	5.15											6.5

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
706-1A	11/18/75	0700	5.30	1725	643	67	108	272	2472	3758	9045	130	-13.5	6.4
	11/18/75	1100	5.40											6.4
	11/18/75	1500	5.30	1710	[illegible]	57	121	320	2622	3580	9109	132	-10.2	5.7
	11/18/75	1900	5.15											5.9
	11/18/75	2300	5.20											6.9
	11/19/75	0300	5.20											7.2
	11/19/75	0700	5.25	1465	704	69	108	48	2363	3651	8408	111	-12.1	8.3
	11/19/75	1100	5.25											7.9
	11/19/75	1500	5.20	1885	757	63	106	272	2572	3829	9484	133	-4.0	6.2
	11/19/75	1900	5.25											6.3
	11/19/75	2300	5.25											6.0
	11/19/75	2307												
	11/19/75	2310												
	11/19/75	2311												
	11/20/75	0300	5.10											5.0
	11/20/75	0700	5.15	1965	732	79	119	72	2745	3616	9328	145	2.3	5.2
	11/20/75	1100	5.25											5.7
	11/20/75	1500	5.10	2295	752	84	115	200	2290	3829	9565	131	12.2	5.6
	11/20/75	1510												
	11/20/75	1900	5.20											5.9
	11/20/75	2300	5.10											6.8
	11/20/75	2307												
	11/20/75	2310												
	11/21/75	0300	5.10											7.6
	11/21/75	0700	5.15	2390	774	91	117	224	1786	3864	9246	105	20.1	8.4
	11/21/75	0707												
	11/21/75	0710												
707-1A	11/21/75	1900	5.50											9.0
	11/21/75	2300	5.55											10.7
	11/22/75	0300	5.60											10.5
	11/22/75	0700	5.60	2015	821	74	121	184	1533	4467	9215	83	6.8	11.0
	11/22/75	1100	5.65											11.4
	11/22/75	1500	5.75	1635	777	87	115	264	791	4644	8313	41	-1.2	11.5
	11/22/75	1900	5.75											11.1
	11/22/75	2300	5.75											10.4
	11/23/75	0300	5.80											10.4
	11/23/75	0700	5.80	2019	919	77	139	200	836	4538	8719	44	17.7	9.9
	11/23/75	1100	5.70											10.2
	11/23/75	1500	5.80	1370	882	83	113	88	840	4502	7879	37	0.5	10.3
	11/23/75	1900	5.80											11.4
	11/23/75	2300	5.75											12.3
	11/24/75	0300	5.80											12.3
	11/24/75	0700	5.85	1385	922	75	135	50	728	4495	7790	32	5.6	13.0
	11/24/75	1100	5.85											13.0
	11/24/75	1500	5.75	1070	824	73	104	168	421	4077	6737	17	-0.7	12.8
	11/24/75	1900	5.80											11.7
	11/24/75	2300	5.80											10.9
	11/25/75	0300	5.80											10.9
	11/25/75	0700	5.75	1425	1011	71	106	136	882	4041	7672	37	15.2	9.8
	11/25/75	1100	5.70											8.8

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

PLA NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
707-1A	11/25/75	1500	5.70	1480	1082	82	120	88	1454	4467	8773	59	6.5	8.2
	11/25/75	1900	5.60											8.7
	11/25/75	2300	5.70											8.9
	11/26/75	0300	5.70											9.1
	11/26/75	0700	5.80	1790	914	53	127	96	1026	4467	8473	51	12.0	9.4
	11/26/75	1100	5.70											9.5
708-1A	11/26/75	1500	5.85	1305	794	103	120	64	913	4077	7366	41	1.1	9.6
	11/26/75	1900	5.95											9.0
	11/26/75	2300	5.60											9.0
	11/27/75	0300	5.80											9.2
	11/27/75	0700	5.85	1850	924	88	129	88	1131	4538	8748	57	12.4	8.8
	11/27/75	1100	5.80											8.6
	11/27/75	1500	5.70	1755	850	80	110	112	1480	4680	9067	74	-1.1	7.3
	11/27/75	1900	5.70											7.0
	11/27/75	2300	5.55											9.1
	11/28/75	0300	5.80											10.0
	11/28/75	0700	5.70	2140	529	82	118	32	1330	4824	9055	85	-4.9	10.0
	11/28/75	1100	5.65											8.7
	11/28/75	1500	5.55	1990	795	83	1 5	120	1386	5347	9826	75	-6.8	7.6
	11/28/75	1900	5.60											7.2
	11/28/75	2300	5.60											7.3
	11/29/75	0300	5.60											7.6
	11/29/75	0700	5.55	2090	815	90	111	112	1568	4831	9617	86	3.6	7.6
	11/29/75	1100	5.60											7.2
	11/29/75	1500	5.60	1635	819	61	114	104	1381	4750	8884	68	-6.4	7.3
	11/29/75	1900	5.65											7.3
	11/29/75	2300	5.60											8.5
	11/30/75	0300	5.45											8.8
	11/30/75	0700	5.50	1675	891	79	111	88	1240	4715	8799	60	1.3	9.4
	11/30/75	1100	5.60											9.1
	11/30/75	1500	5.50	1580	879	79	114	120	1061	4609	8442	50	1.5	9.4
	11/30/75	1900	5.55											10.0
	11/30/75	2300	5.65											10.1
	12/01/75	0300	5.60											11.5
	12/01/75	0700	5.60	1220	823	80	103	240	810	4006	7288	35	-0.5	11.3
	12/01/75	0701	5.70											11.3
	12/01/75	1100	5.90											11.0
	12/01/75	1500	5.65	1248	881	70	112	112	695	4006	7124	29	7.4	10.1
	12/01/75	1900	5.65											10.2
	12/01/75	2300	5.70											10.0
	12/02/75	0300	5.70											9.5
	12/02/75	0700	5.75											9.5
709-1A	12/06/75	1900	5.46											8.6
	12/06/75	2300	5.66											9.4
	12/07/75	0300	5.80											9.8
	12/07/75	0700	5.71	1452	875	74	112	40	1288	4254	8095	58	1.8	9.7
	12/07/75	1100	5.69											9.5
	12/07/75	1500	5.65	2045	737	79	126	64	1246	4538	8835	71	8.1	9.9
	12/07/75	1900	5.70											11.2
	12/07/75	2300	5.92											11.8

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
709-1A	12/08/75	0300	5.85											12.0
	12/08/75	0700	5.84	1045	759	72	109	24	530	4006	6545	22	-3.4	12.4
	12/08/75	1100	5.85											13.2
	12/08/75	1500	5.87	1285	837	71	116	60	529	3651	6567	24	16.6	12.5
	12/08/75	1900	5.90											12.2
	12/08/75	2300	5.99											11.5
	12/09/75	0300	5.90											11.2
	12/05/75	0700	5.86	967	833	66	101	72	980	3439	6458	36	2.5	9.8
	12/09/75	1100	5.91											9.6
	12/09/75	1600	5.95	1185	763	70	109	16	1326	3404	6873	57	2.9	9.2
	12/09/75	1900	5.92											9.4
	12/09/75	2300	5.95											10.0
	12/10/75	0300	5.90											11.1
	12/10/75	0700	5.84	842	778	64	117	104	739	3156	5888	26	4.3	10.3
	12/10/75	1100	5.93											10.6
	12/10/75	1500	5.97	693	508	69	109	80	576	3368	5403	23	-32.6	10.3
	12/10/75	1900	5.98											10.3
	12/10/75	2300	6.01											10.5
	12/11/75	0300	6.06											10.5
	12/11/75	0700	5.99	565	768	60	102	22	634	3261	5412	17	-9.4	11.9
	12/11/75	1100	6.00											11.3
	12/11/75	1500	5.94	607	791	74	119	112	576	3155	5434	16	-2.1	10.6
	12/11/75	1537												
	12/11/75	1900	5.91											10.6
	12/11/75	2300	6.03											9.9
	12/11/75	2301	6.03											10.0
	12/11/75	2307												
	12/12/75	0300	5.99											9.2
	12/12/75	0700	5.86	968	785	75	108	64	978	3651	6629	37	-5.1	8.8
	12/12/75	0707												
	12/12/75	1600	5.90	1048										10.2
710-1A	12/12/75	1500		1048	949	32	115	184	1146	3126	6600	41	13.4	
	12/12/75	1601	5.90											10.3
	12/12/75	1900	5.86											10.6
	12/12/75	2300	5.86											10.8
	12/13/75	0300	5.96											11.4
	12/13/75	0700	5.94	924	867	76	119	96	434	3474	5990	16	11.6	11.9
	12/13/75	1100												11.4
	12/13/75	1500		1022	803	69	120	40	652	3900	6606	26	-1.2	
	12/13/75	1501												10.8
	12/13/75	1502	6.08											10.7
	12/13/75	1900	6.04											10.9
	12/13/75	2300	6.07											10.7
	12/13/75	2301												11.0
	12/14/75	0300	6.06											10.3
	12/14/75	0700	6.03	812	837	73	115	120	448	3687	6092	15	-0.7	11.5
	12/14/75	1100	6.03											10.1
	12/14/75	1500		750	817	71	119	80	577	3332	5746	19	2.5	10.4
	12/14/75	1501												10.4
	12/14/75	1902												9.5

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
710-1A	12/14/75	2300	6.12											9.5
	12/15/75	0300	6.05											9.4
	12/15/75	0700	6.06	1127	841	75	127	64	752	3651	6641	31	9.0	11.1
	12/15/75	1100	6.11											10.8
	12/15/75	1500	6.16	667	797	74	116	72	529	3084	5339	16	5.0	11.6
	12/15/75	1501	6.15											11.8
	12/15/75	1900	6.10											11.3
	12/15/75	2300	6.14											10.9
	12/15/75	2301	6.14											11.1
	12/16/75	0300	6.16											12.1
	12/16/75	0700	6.15											11.8
	12/16/75	0701	6.15											11.8
	12/16/75	1100	6.10											11.4
	12/16/75	1500	6.19	594	761	69	118	64	465	3049	5110	13	0.5	11.3
	12/16/75	1501												11.1
	12/16/75	1900	6.16											11.0
	12/16/75	2300	6.11	624	785	70	109	48	684	3088	5408	20	-1.0	11.2
	12/16/75	2301	6.11											11.3
	12/17/75	0300	6.11											12.0
	12/17/75	0700	6.15	504	713	64	117	136	410	3013	4957	11	-8.2	12.2
	12/17/75	1100	6.07											11.3
	12/17/75	1500		1108	769	73	141	64	558	2942	5655	24	23.2	12.4
	12/17/75	1501												12.6
	12/17/75	1900												11.9
	12/17/75	2300	6.13											9.9
	12/17/75	2301	5.62											9.8
	12/18/75	0300	6.03											9.3
	12/18/75	0700	6.02	745	780	69	109	88	864	3155	5810	28	-1.9	8.5
	12/18/75	1100	5.92											8.6
	12/18/75	1500	5.86	1175	842	70	146	72	1379	3585	7269	56	2.3	7.7
	12/19/75	1900	5.86											9.2
	12/18/75	2300	5.86											8.9
	12/19/75	0300	5.83											9.4
	12/19/75	0301	5.49											9.5
	12/19/75	0700	5.84	1543	415	50	62	112	1229	4219	7630	75	-26.3	10.0
	12/19/75	0701	5.49											10.0
	12/19/75	1100	5.85											11.0
	12/19/75	1500	5.93	980	809	68	109	32	827	3687	6512	31	-0.7	9.8
	12/19/75	1900	5.91											10.1
	12/19/75	2300	5.56											10.6
	12/20/75	0300	5.98											10.8
	12/20/75	0700	5.86	2277	109	35	150	32	1455	3613	7671	118	-3.9	10.0
	12/20/75	0701	5.86											10.1
	12/20/75	1100	5.94											9.9
	12/20/75	1500	5.97	2060	791	68	104	48	1461	3120	7652	81	31.0	10.6
	12/20/75	1900	5.93											11.0
	12/20/75	2300	5.90											11.0
	12/21/75	0300	5.92											11.3
	12/21/75	0700	5.98	1984	797	55	106	120	513	3403	6978	29	35.4	11.3
	12/21/75	0701	5.98											11.5

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
710-1A	12/21/75	1100	5.84											10.0
	12/21/75	1500	5.86	880	739	59	110	80	776	3049	5693	29	5.4	10.1
	12/21/75	1700												9.8
	12/21/75	1900	5.55											10.2
	12/21/75	2100	5.64											10.8
	12/21/75	2300	5.80											11.7
	12/22/75	0100	5.83											11.7
	12/22/75	0300	5.85											12.0
	12/22/75	0500	5.89											11.8
	12/22/75	0700	5.83	2254	135	32	117	16	3397	2902	8853	247	-19.5	11.8
711-1A	12/24/75	1500	5.65	1778	658	56	102	136	1710	2642	7082	93	23.3	8.9
	12/24/75	1900	5.68											8.6
	12/24/75	2300	5.68											8.3
	12/25/75	0300	5.72											8.2
	12/25/75	0700	5.73	1772	849	57	115	64	1258	3793	7910	64	17.7	8.4
	12/25/75	1100	5.72											8.6
	12/25/75	1500	5.81	1035	713	63	105	56	1063	3297	6332	44	-0.7	8.7
	12/25/75	1900	5.75											10.0
	12/25/75	2300	5.76	1781				40	2309	2783				11.5
	12/26/75	0300	5.79											11.4
	12/26/75	0700	5.88	1664	747	59	115	16	1942	2841	7384	97	19.4	11.0
	12/26/75	1100	5.90											11.4
	12/26/75	1500	5.99	1600	691	51	90	32	767	2446	5667	41	38.9	11.7
	12/26/75	1900	5.96											11.4
	12/26/75	2300	5.80											9.5
	12/27/75	0300	5.64											8.7
	12/27/75	0700	5.60	1945	297	40	117	384	905	2978	6666	65	10.9	8.9
	12/27/75	1100	5.75											8.9
	12/27/75	1500	5.58	1790	661	60	85	32	1686	2836	7140	92	21.7	8.0
	12/27/75	1900	5.47											7.6
	12/27/75	2300	5.46											8.4
	12/28/75	0300	5.54											8.2
	12/28/75	0700	5.57	1590	651	61	87	80	1730	4396	8595	90	-17.6	8.4
	12/28/75	1100	5.49											8.0
	12/28/75	1500	5.46	2155	739	74	99	104	1694	4821	9686	97	0.1	8.3
	12/28/75	1900	5.51											8.9
	12/28/75	2300	5.63											10.1
	12/29/75	0300	5.59											10.4
	12/29/75	0700	5.59	1505	337	39	112	32	2039	2623	6687	123	-9.2	9.9
	12/29/75	1100	5.62											9.8
	12/29/75	1500	5.66	1530	757	66	108	48	976	4396	7881	49	-0.9	9.0
	12/29/75	1900	5.68											8.7
	12/29/75	2300	5.57	1825	727	61	103	80	1499	4396	8691	81	-0.7	8.5
	12/30/75	0300	5.61											9.5
	12/30/75	0700	5.72	1977										9.7
	12/30/75	0701	5.72											9.7
	12/30/75	1100												9.6
	12/31/75	1237												
711-1B	12/30/75	1500	5.40	2749	673	60	97	48	2122	2907	8656	135	35.5	8.4
	12/30/75	1900	5.61											9.2

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
711-1B	12/30/75	2300	5.55	1875										9.1
	12/31/75	0300	5.65											9.5
	12/31/75	0700	5.40	1735	355	46	118	72	1838	2978	7142	117	-2.7	9.1
	12/31/75	1100	5.52											9.1
	12/31/75	1500	5.58	1900	834	76	134	64	1555	2907	7470	81	31.8	7.7
	12/31/75	1960	5.58											7.8
	12/31/75	2300	5.55											7.6
	01/01/76	0300	5.56											9.0
	01/01/76	0700	5.57	2835	713	81	115	96	1400	5637	10877	91	7.8	
	01/01/76	1100												8.9
	01/01/76	1500	5.58	3059	771	78	115	144	1971	6559	12697	127	-3.2	
	01/01/76	1900	5.61											8.8
	01/01/76	2300	5.65											8.9
	01/02/76	0300	5.58											10.1
	01/02/76	0700	5.58	2265	761	94	112	112	440	6133	9917	27	-1.3	
	01/02/76	1100	5.58											9.4
	01/02/76	1500	5.86											8.3
712-1A	01/02/76	1900	5.69											8.1
	01/02/76	2300	5.68											8.2
	01/03/76	0300	5.55											8.7
	01/03/76	0700	5.67	2749	731	74	106	56	549	6594	10859	36	2.2	
	01/03/76	1100	5.56											10.4
	01/03/76	1500	5.67	2285	767	70	100	104	464	6169	9959	28	-1.9	
	01/03/76	1900	5.66											10.3
	01/03/76	2300	5.73											10.5
	01/04/76	0300	5.71											10.5
	01/04/76	0700	5.63	2140	789	74	120	40	589	6027	9779	34	-3.0	
	01/04/76	1100	5.07											11.7
	01/04/76	1500	5.74	1575	699	67	114	72	471	5247	8245	25	-12.4	
	01/04/76	1900	5.78											11.9
	01/04/76	2300	5.79											12.0
	01/05/76	0300	5.76											10.7
	01/05/76	0700	5.80	1560	784	61	127	72	360	4824	7788	18	2.0	
	01/05/76	1100	5.79											11.1
	01/05/76	1500	5.86	1451	800	55	117	136	500	4290	7349	24	6.1	
	01/05/76	1900	5.93											11.2
	01/05/76	2300	5.96	1163	754	61	118	40	509	4113	6758	23	-1.5	
	01/06/76	0300	5.89											9.9
	01/06/76	0700	6.00											10.8
	01/06/76	0701	6.00											10.8
	01/06/76	1100	6.03											10.6
	01/06/76	1500	6.10	1060	789	59	110	176	399	4041	6634	16	-2.8	
	01/06/76	1900	5.92											10.0
	01/06/76	2300	5.81	1090	719	55	113	56	538	3900	6471	24	-3.2	
	01/07/76	0300	5.86											12.0
	01/07/76	0700	5.74	1065	784	55	109	96	825	4148	7082	34	-11.2	
	01/07/76	1100	5.98											11.2
712-1B	01/07/76	2200	6.04											9.6
	01/07/76	2230	5.98											
	01/07/76	2300	5.89											9.2

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
712-1B	01/07/76	2330	5.73											
	01/08/76	0000	5.73											9.7
	01/08/76	0030	5.76											
	01/08/76	0100	5.99											10.2
	01/08/76	0130	5.84											
	01/08/76	0200	5.78											10.5
	01/08/76	0230	5.71											
	01/08/76	0300	5.58											10.8
	01/08/76	0330	5.42											
	01/08/76	0400	5.32											11.0
	01/08/76	0430	5.13											
	01/08/76	0500	4.95											10.6
	01/08/76	0530	4.73											
713-1A	01/08/76	1100	5.40											10.9
	01/08/76	1500	5.36	2140	899	48	105	104	2644	4609	10549	136	-1.1	8.4
	01/08/76	1900	5.29											8.2
	01/08/76	2300	5.21											7.3
	01/09/76	0300	5.17											8.0
	01/09/76	0700	5.14	2530	783	67	118	88	1970	5530	11086	117	-1.3	9.2
	01/09/76	1100	5.24											8.0
	01/09/76	1500	5.24	3230	999	70	122	96	1814	5708	12039	112	19.4	7.6
	01/09/76	1900	5.26											8.0
	01/09/76	2300	5.32											7.9
	01/10/76	0300	5.19											7.6
	01/10/76	0700	5.23	2879	947	93	128	96	1951	6452	12546	116	1.7	8.2
	01/10/76	1100	5.28											6.0
714-1A	01/19/76	1900	5.26											9.0
	01/19/76	2300	5.59	370	4129	73	92	616	9584	4538	19402	42	5.7	9.9
	01/20/76	0300	5.79											10.3
	01/20/76	0700	5.85	270	4269	64	88	1425	9773	3829	19718	31	6.1	10.2
	01/20/76	0701	5.85											10.1
	01/20/76	1100	5.66											11.7
	01/20/76	1500	5.54	283	4519	66	60	3210	10911	3900	22949	34	-6.9	13.2
	01/20/76	1900	5.64											13.3
	01/20/76	2300	5.81	208	4859	69	62	3634	12493	3651	24976	27	-9.4	13.8
	01/21/76	0300	5.59											12.9
	01/21/76	0700	5.57	366	5859	63	64	1345	18053	4467	30217	56	-6.1	10.1
	01/21/76	1100	5.73											8.2
	01/21/76	1500	5.69	556	4519	68	67	904	14810	4892	25816	85	-16.0	7.7
	01/21/76	1900	5.61											10.4
	01/21/76	2300	5.63	670	4469	58	54	1032	15669	4609	26561	107	-19.0	10.6
	01/22/76	0300	5.58											10.5
	01/22/76	0301	5.43											10.4
	01/22/76	0700	5.55	667	4799	71	148	864	17415	4360	28324	111	-16.6	10.1
	01/22/76	1100	5.60											9.3
	01/22/76	1500	5.53	854	5469	55	56	1377	16881	5566	30259	125	-9.4	8.4
	01/22/76	1900	5.38											8.7
	01/22/76	2300	5.44	746	6509	57	54	1785	15240	6133	30524	90	7.2	9.3
	01/23/76	0300	5.43											10.6
	01/23/76	0700	5.41	624	4979	49	124	880	14497	5920	27073	87	-10.0	10.7

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
714-1A	01/23/76	1100	5.50											9.8
	01/23/76	1500	5.50	596	4969	66	100	656	13693	5956	26136	92	-4.6	9.1
	01/23/76	1900	5.40											9.3
	01/23/76	2300	5.57	706	4859	60	107	1120	14388	5672	26912	99	-10.7	9.1
	01/24/76	0300	5.90											9.2
	01/24/76	0700	5.55	1200	4899	63	104	976	15117	5637	27996	168	-6.4	9.3
	01/24/76	1100	5.63											9.6
	01/24/76	1500	5.56	634	5249	60	97	736	14730	5318	26824	87	-1.4	8.9
	01/24/76	1900	5.57											7.7
	01/24/76	2300	5.54	769	4349	61	100	1260	13406	5956	25912	107	-19.5	7.8
	01/25/76	0300	5.36											8.8
	01/25/76	0700	5.33	744	5539	48	120	944	15552	6771	29718	102	-8.1	9.5
	01/25/76	1100	5.30											10.0
	01/25/76	1500	5.34	557	5299	52	102	872	14725	6275	27882	76	-7.8	9.3
	01/25/76	1900	5.48											9.4
	01/25/76	2300	5.54	784	4939	55	103	1417	13198	5991	26487	100	-6.4	9.1
	01/26/76	0300	5.57											9.0
	01/26/76	0700	5.67	678	5549	62	99	520	15168	6098	28174	91	-1.1	9.0
715-1A	01/26/76	1900	5.64											
	01/26/76	2300	5.55	730	6379	58	95	1304	14210	6098	28874	84	11.6	14.5
	01/27/76	0300	5.45											14.3
	01/27/76	0700	5.08	750	4319	67	111	2161	12846	5601	25855	103	-20.3	13.2
	01/27/76	0701	5.08											11.9
	01/27/76	1100	4.92											14.8
	01/27/76	1500	5.30	872	4759	63	105	2425	12544	5424	26192	109	-7.8	8.9
716-1A	01/27/76	1900	5.01											6.1
	01/27/76	2300	4.98	1057	5769	69	109	6468	13890	5743	33105	125	-14.9	7.3
	01/28/76	0300	4.78											4.8
	01/28/76	0700	4.66	1208	5199	60	79	1272	10156	4928	22902	115	22.4	1.2
	01/28/76	0701	4.66											1.9
717-1A	01/28/76	1100	4.73											
	01/28/76	1101	4.73											
	01/28/76	1500	5.03	876	4939	75	125	3778	11535	4750	26078	99	-2.6	8.4
	01/28/76	1900	4.78	1048	4679	73	121	8646	9331	4609	28507	101	-21.8	
	01/28/76	2300	5.70	796	4759	54	110	2265	13173	4077	25234	104	-2.2	11.5
	01/29/76	0300	5.80											8.8
	01/29/76	0700	5.61	1260	5379	65	99	1000	13797	5353	26953	153	9.3	9.2
	01/29/76	1100	5.66											8.9
	01/29/76	1500	5.64	675	5379	68	102	496	13985	5530	26235	87	4.6	8.9
	01/29/76	1900	5.55											9.5
	01/29/76	2300	5.61	590	5079	73	129	472	14629	4963	25935	82	-0.6	10.3
	01/30/76	0300	5.45											10.3
	01/30/76	0700	5.47	541	4079	64	85	1000	12804	4431	23004	78	-13.3	10.3
	01/30/76	1100	5.44		5109									10.9
	01/30/76	1540	5.42	525	5079	69	79	1457	13433	3864	24506	68	5.3	9.8
	01/30/76	1900	5.48		4729									9.6
	01/30/76	2330	5.46	540	5719	70	111	1288	16728	4254	28710	78	0.6	9.7
	01/31/76	0300	5.44											9.9
	01/31/76	0700	5.53	422	4349	44	96	1521	14066	3368	23866	64	-11.1	10.1
	01/31/76	1100	5.54											10.1

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
717-1A	01/31/76	1530	5.45	572	4589	48	87	2674	15941	3013	26924	92	-17.9	9.9
	01/31/76	1900	5.35											11.2
	01/31/76	2300	5.43	655	4629	68	253	1921	16268	2586	26382	105	-8.7	10.2
	02/01/76	0300	5.54											10.5
	02/01/76	0700	5.45	654	3839	32	89	1985	14304	2446	23349	107	-18.2	9.7
	02/01/76	1100	5.40											10.2
	02/01/76	1530	5.40	658	4659	41	85	2625	16893	2198	27189	113	-13.7	8.6
	02/01/76	1900	5.47											10.1
	02/02/76	0700	5.15	396	5059	38	96	2369	16821	1914	26693	63	-5.3	11.9
	02/02/76	1100	5.57											10.9
	02/02/76	1545	5.48	569	4589	46	81	1489	17065	1772	25611	96	-7.9	10.1
	02/02/76	1900	5.44											10.4
	02/02/76	2330	5.50	507	5699	51	79	1505	20144	1595	29580	86	-0.7	10.2
	02/03/76	0300	5.22											10.2
	02/03/76	0730	5.57	622	5579	32	102	1008	18355	1879	27577	98	6.8	9.9
	02/03/76	1130	5.66											9.6
	02/03/76	1530	5.55	559	4619	36	94	2001	18436	1843	27588	100	-18.0	10.2
	02/03/76	1930	5.46											11.3
	02/03/76	2330	5.49	451	5309	38	77	2842	20030	2098	30845	80	-18.2	11.0
	02/04/76	0330	5.47											9.9
	02/04/76	0730	5.28	667	5649	38	99	2201	18236	2269	29159	104	0.7	9.7
	02/04/76	1130	5.29											10.6
	02/04/76	1530	5.45	541	4869	43	94	2361	16971	2907	27786	88	-14.5	10.7
	02/04/76	1930	5.23											9.8
	02/04/76	2330	5.22	634	5179	41	112	1601	17645	2800	28012	102	-5.2	9.6
	02/05/76	0330	5.38											9.7
	02/05/76	0730	5.35	608	4779	37	110	968	16039	2552	25093	95	-0.5	9.9

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
625-1A	06/20/75	2300	3160	950	66.7	24.20	18.30	6.63	29.50	2.15	4.5	2.12	22.5	1.13	3.3
	06/21/75	1500	2880	800	69.2	20.50	15.40	7.15	26.40	1.80	8.6	4.61	27.1	1.12	-1.4
	06/21/75	2300	3200	960	66.8	23.60	19.40	6.35	30.60	1.54	8.1	3.91	20.8	1.09	0.9
	06/22/75	1500	3020	880	68.3	23.10	17.60	8.05	30.30	1.25	8.6	4.14	26.6	1.08	1.2
	06/22/75	2300	3040	760	72.3	24.80	20.00	7.20	32.20	1.48	8.4	3.81	22.4	1.08	1.4
	06/23/75	1500	3120	920	67.3	26.20	23.10	7.13	36.00	2.12	8.3	3.37	19.8	1.11	-6.6
	06/23/75	2300	2400	500	76.9	24.90	20.70	7.03	32.90	2.16	7.4	3.28	21.4	1.12	-3.6
	06/24/75	1500	2600	560	76.1	23.40	17.30	8.78	30.40	2.23	7.7	3.56	28.9	1.13	-3.1
	06/25/75	1500	2880	560	78.5	25.50	21.90	6.93	34.30	2.92	8.5	3.55	20.2	1.15	-8.8
	06/25/75	2300	2320	360	82.8	25.90	22.30	7.03	34.90	2.12	6.9	2.87	20.1	1.11	-4.8
	06/30/75	1600	3200	560	80.6	27.30	19.50	15.03	39.40	1.89	7.3	2.30	38.1	1.09	-9.9
	06/30/75	2300	3200	740	74.4	30.90	23.50	6.23	35.60	2.39	8.7	3.22	17.5	1.12	9.4
	07/01/75	1500	2560	360	84.4	29.40	17.70	11.48	33.60	2.29	8.6	3.09	34.2	1.12	10.0
	07/01/75	2300	2720	460	81.3	25.90	18.70	7.43	30.80	1.87	8.9	4.00	24.1	1.11	7.5
	07/02/75	1500	2280	280	86.4	27.90	22.60	3.85	32.10	2.23	9.4	4.14	12.0	1.13	9.2
	07/02/75	2300	2000	200	89.0	27.60	16.60	11.55	32.30	2.30	8.0	3.09	35.8	1.13	7.4
	07/03/75	1500	2090	80	95.8	27.40	16.00	11.80	31.80	1.95	8.7	3.41	37.1	1.11	9.6
	07/03/75	2300	2040	300	83.7	28.50	16.10	12.38	32.50	2.33	8.3	3.03	38.1	1.13	9.7
	07/04/75	1500	2640	480	79.9	24.20	17.40	9.05	30.80	1.54	8.2	3.72	29.4	1.09	2.7
	07/04/75	2300	3120	680	75.9	30.00	21.40	5.45	32.20	1.64	8.5	3.52	16.9	1.09	17.8
	07/05/75	1500	2280	340	83.5	23.20	20.20	6.25	31.50	1.59	8.4	4.07	19.9	1.09	-3.8
	07/05/75	2300	2680	400	83.5	20.40	18.60	6.45	29.70	1.86	8.5	4.41	21.7	1.11	-13.6
	07/06/75	1500	2640	520	78.2	26.90	22.00	6.50	34.00	1.64	8.2	3.46	19.1	1.09	3.7
	07/06/75	2300	3160	740	74.1	26.80	21.90	6.23	33.60	1.64	8.0	3.45	18.5	1.09	4.4
	07/07/75	2300	2880	340	86.9	22.80	17.90	7.53	29.90	2.05	9.2	4.44	25.2	1.12	-3.3
	07/08/75	1500	3120	420	85.1	26.30	21.50	4.13	31.00	2.07	7.5	3.49	13.3	1.12	7.4
	07/08/75	2300	3290	640	77.9	28.10	21.30	6.28	32.90	2.07	7.6	3.20	19.1	1.11	8.6
626-1A	07/09/75	1500	3280	700	76.4	30.30	24.00	7.30	37.30	1.80	8.8	3.16	19.6	1.09	6.2
	07/09/75	2300	3320	760	74.6	30.70	22.90	3.58	32.20	1.57	8.7	3.65	11.1	1.09	20.0
	07/10/75	1500	3000	560	79.3	25.30	21.00	5.45	31.70	1.59	8.4	3.89	17.2	1.09	4.2
	07/10/75	2300	3240	580	80.2	25.60	21.90	6.13	33.50	2.48	8.0	3.50	18.3	1.13	-4.0
	07/11/75	1500													
	07/11/75	1501	2900	540	79.4	26.70	21.00	9.75	36.00	1.56	8.5	3.31	27.1	1.08	-1.9
	07/11/75	1502	2920	540	79.5	23.80	19.10	8.83	32.70	1.50	8.2	3.85	27.0	1.08	-4.3
	07/11/75	2300	2880	460	82.3	22.70	18.00	4.50	27.00	1.64	8.7	4.62	16.7	1.11	7.5
	07/12/75	1500	3520	780	75.5	25.80	20.60	5.75	31.50	1.92	8.8	4.02	18.3	1.11	5.0
	07/12/75	2300	3320	640	78.7	27.10	23.20	4.40	33.40	2.18	8.5	3.74	13.2	1.12	3.4
	07/13/75	1500	3320	740	75.3	27.80	21.90	5.73	33.10	1.63	8.1	3.47	17.3	1.09	9.1
	07/13/75	2300	3420	820	73.4	28.30	25.90	1.33	33.70	1.86	8.4	3.81	3.9	1.10	8.2
	07/14/75	1500	3120	680	75.9	25.00	21.60	6.70	33.70	1.52	6.7	3.86	19.9	1.08	-2.2
	07/14/75	2300	3560	940	70.7	26.20	19.50	7.63	32.00	1.15	8.6	3.79	23.8	1.07	8.9
	07/15/75	0700	3600	960	70.5	26.80	24.10	5.68	35.80	1.43	9.1	3.82	15.9	1.07	-0.4
	07/15/75	1600	3680	900	72.9	24.80	22.90	6.48	35.10	1.85	8.7	3.82	18.5	1.10	-8.6
	07/15/75	2300	3200	740	74.4	26.70	23.90	5.43	35.30	1.62	8.4	3.56	15.4	1.09	-0.3
	07/16/75	0700	3120	640	77.3	27.30	23.80	6.35	36.10	1.49	8.3	3.42	17.6	1.09	0.4
	07/16/75	1500	2960	620	76.8	25.00	23.90	5.43	35.30	2.19	8.2	3.62	15.4	1.11	-10.1
	07/16/75	2300	3240	720	75.4	26.80	21.60	8.10	35.10	2.29	8.2	3.26	23.1	1.12	-2.6
	07/17/75	0700	3320	700	76.6	31.60	22.10	10.56	36.20	1.48	8.6	2.72	27.7	1.07	9.4
	07/17/75	1500	2800	560	77.5	25.40	21.00	6.75	33.00	1.23	8.2	3.69	20.5	1.07	2.8
	07/17/75	2300	3040	700	74.5	25.80	23.30	5.98	35.10	1.60	8.3	3.58	17.0	1.08	-3.2
	07/18/75	0700	3440	940	69.7	25.90	24.10	4.78	34.90	1.59	8.9	3.93	13.7	1.08	-2.2

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
626-1A	07/18/75	1500	3200	780	73.0	26.10	24.10	5.68	35.80	2.03	8.7	3.70	15.9	1.10	-6.0
	07/18/75	2300	3280	820	72.3	26.10	24.00	5.20	35.20	1.67	8.4	3.63	14.8	1.09	-2.6
	07/19/75	0700	3440	940	69.7	25.70	24.00	6.00	36.00	1.59	8.3	3.57	16.7	1.08	-6.0
	07/19/75	1500	3000	720	73.4	25.50	21.40	8.25	35.00	1.97	8.4	3.50	23.6	1.10	-6.0
	07/19/75	2300	2080	320	83.0	23.90	14.50	10.08	28.20	2.03	7.6	3.51	35.7	1.13	6.5
	07/20/75	1500	2480	440	80.4	22.70	14.70	7.13	25.50	2.03	8.5	4.38	28.0	1.14	9.9
	07/20/75	2300													
	07/21/75	1500	2600	480	79.6	24.00	17.60	7.50	29.50	1.59	8.1		25.4	1.10	5.5
	07/21/75	2300	3000	680	74.9	26.20	17.80	7.95	30.20	1.09	8.7		26.3	1.07	14.0
	07/22/75	0500				23.80	17.10	8.13	29.50	1.31	9.6		27.6	1.08	6.2
	07/23/75	1700	2960	560	78.3	22.40	16.10	7.18	27.30	1.25	9.1		26.3	1.08	7.5
	07/23/75	2300	3000	620	77.1	24.10	20.00	5.40	30.40	1.48	8.3		17.8	1.09	3.8
	07/24/75	0500	2920	540	79.5	25.10	20.10	6.88	32.00	1.69	8.6		21.5	1.10	2.1
	07/24/75	1500	3320	620	79.3	24.10	14.90	11.78	30.40	1.96			38.7	1.12	1.3
	07/24/75	2300	2000	280	84.5	25.30	20.40	6.50	32.00	1.86	8.6		20.3	1.11	2.0
	07/25/75	0700	1440	80	93.9	23.50	15.10	7.33	26.20	2.41	7.5		28.0	1.17	8.8
	07/25/75	1500	2280	240	88.4	22.50	16.50	4.68	25.50	2.51	8.5		19.1	1.18	6.4
	07/25/75	2300	3120	700	75.1	21.10	16.30	5.33	25.70	1.97			20.7	1.14	2.8
	07/26/75	0700	3320	760	74.0	25.40	19.70	5.88	30.50	1.88	8.6		19.3	1.11	6.5
	07/26/75	1502	2720	420	82.9	24.80	19.40	6.85	31.10	1.44	9.1		22.0	1.08	4.8
	07/26/75	2300	2960	500	81.3	25.90	20.60	3.35	29.10	0.75			11.5	1.05	17.6
	07/27/75	0700	3120	600	78.7	26.70	19.10	4.83	28.70	2.11			16.8	1.13	14.6
	07/27/75	1500	3240	600	79.5	25.20	19.70	3.68	23.30	1.66			13.0	1.11	12.9
	07/27/75	2300	1920	220	87.3	23.80	16.00	9.50	29.50	1.30			32.2	1.08	6.2
	07/28/75	1500	1560	110	92.2	22.10	14.80	6.50	27.00	2.04	8.4	4.23	31.5	1.14	2.7
	07/28/75	2300	1520	260	81.1	22.80	16.50	6.28	26.90	2.12	8.3	4.26	23.3	1.14	5.5
	07/29/75	0700	2280	310	85.0	22.80	16.90	5.38	26.50	1.73	9.6	5.06	20.3	1.12	8.9
	07/29/75	1500	2400	360	83.4	24.20	15.30	9.68	29.00	2.35	9.4	4.29	34.1	1.15	3.7
	07/30/75	1500	3200	960	66.8	24.30	20.10	5.06	30.20	1.29	8.9	4.37	16.8	1.08	6.2
	07/30/75	2300	2680	580	76.0	24.70	20.10	6.08	31.20	1.54	6.2	3.85	19.5	1.09	3.6
	07/31/75	1502	2800	490	81.0	21.60	16.30	6.63	27.00	1.24			24.5	1.09	5.1
	07/31/75	2300													
	07/31/75	2302	2520	420	81.6	22.10	17.00	9.05	30.30	1.93			29.9	1.12	-7.2
	08/01/75	1500	2040	220	88.1	21.30	14.20	11.75	29.50	1.86	7.7		39.8	1.11	-8.1
	08/01/75	2300	1720	160	89.7	20.40	12.90	12.98	29.10	1.44	7.5		44.6	1.09	-8.9
	08/02/75	0700	1560	80	94.4	19.50	15.20	9.40	28.40	1.94	7.5	3.86	33.1	1.12	-14.7
	08/02/75	1500	2320	440	79.0	23.50	16.20	6.65	27.10	2.28	8.1	4.01	25.3	1.15	6.9
	08/02/75	2300													
	08/02/75	2302		360		19.90	15.60	10.10	29.60	0.60	8.7	4.46	34.1	1.04	-8.0
	08/03/75	0700	2720	590	76.4	20.20	15.80	8.55	28.30	1.68	8.6	4.44	30.2	1.11	-8.7
	08/03/75	1500	1720	360	76.8	23.40	19.40	5.55	29.80	1.38	7.5	3.76	18.6	1.08	3.3
	08/03/75	2300	1520	140	89.8	19.90	14.80	9.90	28.40	1.68	7.3	3.72	34.9	1.11	-10.7
	08/04/75	0700	1880	220	87.1	19.20	12.50	11.78	27.40	1.72	7.5	3.82	43.0	1.11	-11.4
627-1A	08/05/75	1500	3480	900	71.3	22.70	17.10	6.83	28.20	0.90	10.4		24.2	1.06	7.9
	08/05/75	2300	3480	760	75.8	22.90	16.70	8.03	28.90	1.20	14.7		27.8	1.08	4.9
	08/06/75	1500	1560	40	97.2	23.80	19.60	4.10	28.60	2.58	14.6		14.3	1.16	2.0
	08/06/75	2300	1600	40	97.3	24.60	15.20	4.30	28.30	2.36			15.2	1.15	7.1
	08/07/75	1500	1600	50	96.6	24.00	17.60	5.00	27.00	3.19	14.8	7.36	18.5	1.21	4.3
	08/07/75	2300	1440	30	97.7	24.60	18.00	3.90	26.40	3.27	14.8		14.8	1.23	7.9
	08/08/75	0700	1480	40	97.1	24.80	22.50	3.78	31.90	2.26	16.0	7.55	11.8	1.13	-1.7
	08/08/75	1215	2800	180	92.9	24.30	17.20	5.20	26.70	3.72	15.0	7.35	19.5	1.25	3.5

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
627-1A	08/08/75	2300	3560	400	87.6	24.90	20.60	5.45	31.20	3.21	15.5	7.06	17.5	1.19	-4.2
	08/09/75	0700													
	08/09/75	1500				24.50	21.60	5.40	32.40	1.91	15.9		16.7	1.11	-2.6
	08/09/75	2300				24.60	23.10	3.63	32.50	1.96	14.7		11.2	1.11	-1.9
	08/10/75	0700	3280	720	75.7	24.70	22.20	5.25	33.00	2.22	15.4		15.9	1.12	-5.0
	08/10/75	1500	3640	1240	64.2	24.30	21.90	4.73	32.10	1.49	15.8		14.7	1.08	-0.3
	08/10/75	2300													
	08/11/75	1500	2200	340	82.9	24.60	23.30	3.68	32.80	1.65	14.9	7.12	11.2	1.09	-1.9
	08/11/75	2300	3200	940	70.9	24.50	23.00	3.65	32.40	2.08	14.6	6.96	11.3	1.12	-3.5
	08/12/75	1500	2480	360	83.9	24.60	21.50	5.93	32.80	2.17	15.5	7.05	18.1	1.12	-4.6
	08/12/75	2300	3000	600	77.9	25.60	23.10	5.33	34.20	2.06	15.0	6.60	15.6	1.11	-3.8
	08/13/75	0700													
	08/13/75	1100	1280	160	86.2	25.00	22.10	5.08	32.70	1.83	15.0		15.5	1.10	-0.5
628-1A	08/16/75	1500	2640	360	84.9	25.30	23.50	3.43	32.80	2.34	11.2	5.18	10.5	1.13	-2.6
	08/16/75	2300	1380	40	97.1	25.40	20.00	6.00	31.00	3.15	10.6	4.75	19.4	1.18	-1.3
	08/17/75	0700	1120	20	98.1	25.00	20.50	3.68	29.30	2.37	10.3	5.03	12.6	1.15	5.8
	08/17/75	1500	1160	20	98.1	25.20	19.90	3.23	28.10	2.70	10.1	5.02	11.5	1.17	8.2
	08/17/75	2300	1120	60	94.1	24.00	16.90	8.38	29.50	1.54	10.6	5.02	28.4	1.09	5.7
	08/18/75	0700													
	08/18/75	1500	1200	120	89.0	21.40	15.60	5.70	25.20	1.83	11.6	6.34	22.6	1.13	6.6
	08/18/75	2300	1960	160	91.0	21.60	13.00	10.15	26.40	1.56	11.9	5.98	38.5	1.11	5.2
	08/19/75	0700													
	08/19/75	1500	3280	960	67.6	25.10	23.50	4.13	33.50	1.42	13.6	6.33	12.3	1.08	-0.7
	08/19/75	2300	2800	400	84.2	24.40	22.50	4.18	32.30	1.73	12.5	5.98	12.9	1.10	-1.8
	08/20/75	0700													
	08/20/75	1500	3000	660	75.6	24.00	20.30	5.23	30.60	1.63	11.8	5.75	17.1	1.10	2.0
	08/20/75	2300	3000	640	76.4	23.70	20.00	5.80	30.80	1.40	12.5	6.07	18.8	1.08	1.4
	08/21/75	1500	2920	540	79.5	22.60	17.60	6.80	28.80	1.79	12.1	6.04	23.6	1.11	0.6
	08/21/75	2300	2240	300	85.2	25.10	20.90	7.08	33.20	1.76	12.8	5.63	21.3	1.10	-1.7
	08/22/75	0700	1520	90	93.5	23.70	17.30	8.28	29.90	1.98	11.0	5.13	27.7	1.12	1.0
	08/22/75	2300	2880	580	77.7	22.00	18.40	5.80	28.80	1.68	12.8	6.57	20.2	1.11	-1.4
	08/23/75	0700	3320	760	74.6	23.90	18.80	7.80	31.30	1.79	12.5	5.76	24.9	1.10	-1.3
	08/23/75	1500	2760	500	79.9	23.40	21.10	4.83	31.20	1.52	12.8	6.29	15.5	1.09	-1.7
	08/23/75	2300	2800	520	79.4	23.80	20.00	5.90	30.90	1.89	12.5	5.98	19.1	1.11	-1.1
	08/24/75	0700	2300	130	93.8	24.00	18.30	7.73	30.60	1.82	10.9	5.09	25.3	1.11	1.0
	08/24/75	1500	3280	800	73.0	24.00	21.70	4.88	32.00	2.12	12.2	5.77	15.2	1.12	-4.7
	08/24/75	2300	3520	900	71.7	25.00	23.10	4.53	33.40	2.16	12.6	5.75	13.6	1.12	-4.6
	08/25/75	0700													
	08/25/75	2300	2920	500	81.0	25.30	22.80	5.60	34.10	1.46	10.4	4.66	16.4	1.08	-1.8
	08/26/75	0700													
	08/26/75	1500	3200	680	76.5	25.00	22.00	5.90	33.40	1.22	9.6	4.42	17.7	1.07	0.2
	08/26/75	2300	3580	930	72.1	26.10	22.10	8.18	35.80	1.23	9.6	3.94	22.8	1.06	-2.1
	08/27/75	0700													
	08/27/75	1500	3240	620	72.0	25.80	20.10	10.28	35.40	0.96	9.7	3.90	29.0	1.05	-0.9
	08/27/75	2300	2960	590	78.3	25.90	21.90	7.53	34.90	1.15	9.5	4.04	21.6	1.06	0.3
	08/28/75	1500	2320	240	88.6	25.70	20.80	8.00	34.00	1.56	9.0	3.82	23.5	1.08	-0.4
	08/28/75	2300	2480	540	79.2	26.20	18.90	10.38	34.00	2.14	9.3	3.68	30.5	1.11	-1.7
	08/29/75	0700	3240	700	76.1	24.70	20.00	7.40	32.40	2.22	8.8	3.90	22.9	1.12	-3.3
	08/29/75	2300	3280	660	77.7	25.10	21.00	7.55	33.80	1.35	9.3	4.04	22.3	1.08	-2.2
	08/30/75	0700	3560	520	83.8	24.60	21.60	5.80	32.80	2.25	10.0	4.54	17.7	1.12	-5.1
	08/30/75	1500	2920	200	92.4	24.60	22.80	3.70	32.20	0.54	9.5	4.64	11.5	1.03	5.5

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
628-1A	08/30/75	2300	2600	230	90.2	24.00	19.30	7.28	31.40	1.50	8.6	4.02	23.2	1.09	0.4
	08/31/75	0700	2640	160	93.8	23.90	16.90	8.58	29.70	1.94	9.3	4.31	28.9	1.12	2.6
	08/31/75	1500	2640	100	95.8	23.30	18.80	7.00	30.50	0.54	8.7	4.30	23.0	1.03	5.4
	09/01/75	2300	2320	240	88.5	24.30	20.30	6.73	32.10	0.48	9.9	4.69	21.0	1.03	5.0
	09/02/75	0700													
	09/02/75	1500	2280	240	88.4	24.60	20.50	6.28	31.90	1.73	9.8	4.04	19.7	1.10	1.0
	09/02/75	2300	1760	100	93.7	23.60	16.10	3.68	28.80	1.98	8.3	3.93	30.1	1.13	3.8
	09/03/75	0700	2800	480	81.0	25.60	19.00	8.55	32.30	1.76	9.1	3.91	26.5	1.10	2.9
	09/04/75	2300	2080	150	92.0	23.50	16.20	8.95	29.20	1.72	9.7		30.7	1.11	3.6
	09/05/75	0700	3360	540	82.2	25.50	21.10	6.13	32.50	1.68			18.9	1.09	2.3
	09/05/75	2300	1680	100	93.4	24.70	18.60	7.65	30.90	2.28	8.1	3.65	24.8	1.13	0.6
	09/06/75	0700	1720	80	94.9	24.70	16.50	7.18	27.80	2.72	8.0	3.82	25.8	1.18	7.1
	09/06/75	1500	3080	510	81.7	24.50	18.10	7.28	29.90	2.65	9.2	4.22	24.3	1.16	0.7
	09/06/75	2300	3080	540	80.6	24.10	19.30	7.18	31.30	1.88	9.1	4.20	22.9	1.11	-0.9
	09/07/75	0700	2880	80	97.0	25.60	21.20	6.40	32.90	2.01	8.1	3.55	19.5	1.11	0.0
	09/07/75	1500	2320	280	86.7	26.30	18.30	4.63	27.50	6.55	8.3	3.59	16.8	1.43	-3.0
	09/07/75	2300				24.30	17.23	8.67	30.20	1.84	8.8		28.7	1.11	3.3
	09/08/75	0700													
	09/08/75	1500	3390	600	80.3	25.00	20.20	6.95	32.20	2.20	9.3	4.14	21.6	1.12	-1.4
	09/08/75	2300	3680	1040	68.7	24.90	17.10	9.83	31.20	1.06	9.4	4.20	31.5	1.06	6.6
	09/09/75	0700													
	09/09/75	2300	3520	800	74.8	25.00	23.30	5.88	35.00	1.13	9.3	4.16	16.8	1.06	-3.8
	09/10/75	0700													
	09/10/75	1500	3920	1170	66.9	25.30	21.10	8.33	34.70	1.31	9.2	3.86	24.0	1.10	-5.7
	09/10/75	2300	3600	400	87.7	25.30	23.00	6.35	35.10	1.82	9.0	3.87	18.1	1.09	-6.3
	09/11/75	1500	3960	1000	72.0	25.40	23.00	6.15	34.90	1.77	9.5	4.14	17.6	1.09	-5.1
	09/11/75	2300	4040	950	73.9	25.40	21.00	9.75	35.60	1.83	9.8	3.98	26.3	1.09	-7.4
	09/12/75	0700	3600	700	79.5	25.40	22.60	6.25	34.50	1.67	8.6	3.76	18.1	1.09	-3.5
	09/12/75	2300	3080	520	81.3	26.60	19.70	10.88	35.50	2.14	9.1	3.44	30.6	1.11	-3.7
	09/13/75	0700	2160	40	98.0	24.50	20.40	6.00	31.50	2.08	7.6	3.52	19.1	1.12	-0.9
	09/13/75	1500	3440	680	78.1	25.40	22.10	4.78	32.40	2.22	9.8	4.50	14.8	1.12	-0.5
	09/13/75	2300	3460	700	77.7	24.90	20.40	6.50	32.00	1.71	9.9	4.52	20.3	1.10	1.2
	09/14/75	0700	3240	340	88.4	24.80	20.70	6.93	32.80	1.97	8.4	3.76	21.1	1.11	-2.6
	09/14/75	1500	3160	490	83.2	24.80	21.20	6.50	33.40	2.41	7.0	3.07	20.7	1.13	-6.7
	09/14/75	2300	3880	960	72.6	25.90	16.40	11.20	34.20	1.23	9.0	3.61	32.8	1.07	1.5
	09/15/75	1500	3480	700	77.7	26.80	19.40	12.15	36.40	1.39	8.9	3.28	33.4	1.07	-1.7
	09/15/75	2300	3280	660	77.7	26.20	21.70	7.88	35.00	1.05	8.3	3.49	22.5	1.05	1.3
	09/16/75	0700													
	09/16/75	1200													
	09/16/75	1500	3000	600	77.9	24.90	20.90	6.18	32.30	1.49	6.7	3.07	19.1	1.08	1.5
	09/16/75	2300	2980	540	79.2	25.40	21.00	6.45	32.70	1.49	7.9	3.57	19.7	1.08	2.4
	09/17/75	0700													
	09/17/75	1500	2800	160	93.7	24.10	18.60	6.95	30.20	1.64	9.8	4.19	23.0	1.10	3.6
	09/17/75	2300	3240	500	82.9	25.90	22.40	4.70	32.70	1.65	3.4	3.83	14.4	1.10	2.5
628-1B	09/18/75	1500	1960	50	97.2	24.10	18.00	6.90	29.40	2.13	8.0	3.82	23.5	1.13	3.3
	09/18/75	2300	1600	120	91.7	22.60	17.40	6.35	28.10	1.85	7.8	3.98	22.6	1.12	2.5
	09/19/75	0700	1600	160	90.2	22.10	15.60	7.20	26.70	2.13	7.6	3.90	27.0	1.15	3.1
	09/19/75	2300	3560	700	78.2	25.00	21.90	5.63	33.00	1.67	9.5	4.35	17.1	1.09	-1.0
	09/20/75	0700	3690	760	76.6	24.30	20.60	6.85	32.60	2.21	9.1	4.04	21.0	1.12	-3.0
	09/20/75	1500	2960	460	82.9	24.40	19.50	7.63	32.00	2.00	9.2	4.13	23.8	1.11	-2.3
	09/20/75	2300	3680	580	82.6	25.90	21.50	8.73	35.60	1.35	9.4	3.83	24.5	1.07	-2.9

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
628-10	09/21/75	0700	3860	640	81.6	25.30	22.00	5.90	33.40	1.88	9.1	4.05	17.7	1.10	-1.9
	09/21/75	1500	3440	660	78.8	25.40	22.50	6.06	34.20	2.72	9.7	4.17	17.8	1.14	-8.0
	09/21/75	2300	3200	340	88.3	24.90	20.00	7.30	32.30	1.44	9.0	4.07	22.6	1.08	1.8
	09/22/75	1500	3090	460	83.5	24.10	20.30	7.13	32.50	1.81	9.3	4.25	21.9	1.10	-4.0
	09/22/75	2300	3160	380	86.7	25.20	20.00	7.70	32.70	1.36	9.5	4.22	23.6	1.08	2.2
	09/23/75	0700	3320	520	82.7	23.70	19.60	5.20	29.70	1.50	9.2	4.61	17.5	1.09	4.2
	09/23/75	1500	2800	220	91.3	23.90	18.10	7.88	30.50	1.25	8.5	4.01	25.8	1.07	3.9
	09/23/75	2300	2680	210	91.4	25.10	19.20	7.70	31.70	2.34	8.6	3.82	24.3	1.13	-0.3
	09/24/75	1500	2760	280	88.4	24.60	19.00	8.15	31.90	1.70	9.4	4.23	25.6	1.10	0.4
	09/24/75	2300	2920	200	92.4	24.60	19.50	6.73	31.10	2.26	9.3	4.29	21.6	1.13	-0.3
	09/26/75	2300	3120	660	76.6	25.20	21.70	5.28	32.40	1.68	9.6		16.3	1.09	1.4
	09/27/75	0700	3320	560	81.3	24.40	18.90	8.08	31.70	1.89	10.2		25.5	1.11	-0.9
	09/27/75	1500	2960	570	80.6	25.50	22.20	6.55	34.30	1.11	9.2		19.1	1.06	0.2
	09/27/75	2300													
	09/27/75	2302	3120	520	81.6	25.40	20.40	6.90	32.40	3.00	9.0		21.3	1.17	-4.4
	09/28/75	0700	3800	560	83.7	24.60	22.00	4.10	31.60	4.19	9.9	4.51	13.0	1.24	-11.7
	09/28/75	1500	2960	260	90.3	24.80	20.50	6.28	31.90	2.86	9.7	4.33	19.7	1.16	-4.8
	09/28/75	2300	2920	280	89.4	24.90	20.70	5.73	31.60	1.93	9.6	4.47	18.1	1.11	0.8
	09/29/75	1500													
	09/29/75	1502	2040	140	92.4	24.60	19.70	6.18	30.80	2.20	9.0	4.21	20.1	1.13	0.9
	09/29/75	2300													
	09/29/75	2302	1840	100	94.6	26.90	18.80	9.90	33.40	2.25	7.8	3.12	29.7	1.12	2.4
	09/30/75	0700	2400	200	90.8	25.00	19.40	6.25	30.50	2.83	8.7	3.97	20.5	1.17	0.1
	09/30/75	1500	3240	300	89.8	24.70	19.60	5.90	30.40	2.94	9.7	4.49	19.4	1.18	-1.4
	09/30/75	2300	2800	380	85.0	25.20	19.20	9.00	33.00	2.64	9.9	4.15	27.3	1.15	-5.1
	10/01/75	1500	2920	320	87.9	26.10	22.40	5.90	33.90	2.50	9.6	4.10	17.4	1.13	-3.2
	10/01/75	1501	2540	360	85.8	25.60	22.50	5.03	32.90	2.44	9.6	4.29	15.3	1.13	-2.2
	10/01/75	2300	3000	500	81.6	26.00	19.40	8.55	32.80	1.11	9.3	4.01	26.1	1.06	6.2
	10/01/75	2301	3000	510	81.2	25.50	21.60	5.50	32.50	2.05	9.3	4.18	16.9	1.11	0.5
	10/02/75	1500	3040	520	81.1	25.40	22.70	5.53	33.90	1.94	9.4	4.17	16.3	1.10	-3.2
	10/02/75	1501	3020	510	81.3	25.40	22.50	5.78	33.90	1.94	9.4	4.14	17.0	1.10	-3.2
	10/02/75	2300	3000	490	82.3	24.10	20.30	6.63	32.20	2.08	8.7	4.00	21.2	1.12	-4.6
	10/02/75	2301	3180	520	81.9	24.20	20.40	6.80	32.30	2.55	8.7	3.94	21.1	1.14	-6.9
	10/03/75	2300	1920	100	94.3	24.90	19.30	6.48	30.60	1.09	8.4	3.95	21.2	1.06	8.3
	10/03/75	2301	1920	100	94.3	24.90	19.80	5.65	30.60	1.32	8.4	3.97	19.1	1.08	7.2
	10/04/75	0700				24.80	19.20	7.30	31.30	1.65	8.7	4.00	23.3	1.10	3.1
	10/04/75	0701				24.60	19.40	7.05	31.30	2.41			22.5	1.14	-0.8
	10/04/75	1500				25.80	21.50	6.93	33.80	1.74	9.1	3.95	20.5	1.09	-0.4
	10/04/75	1501				25.90	21.30	7.28	33.90	2.62	9.1	3.88	21.5	1.11	-1.6
	10/04/75	2300				24.70	22.90	3.78	32.40	2.16	9.5	4.89	11.7	1.12	-3.0
	10/05/75	0700	3600	680	79.1	24.80	23.10	5.13	34.00	1.90	9.3	4.22	15.1	1.10	-5.8
	10/05/75	1500	3200	620	79.5	26.70	24.00	6.30	36.30	1.60	9.5	3.91	17.4	1.08	-2.9
	10/05/75	1501	3180	610	78.9	26.60	23.70	6.18	35.80	1.83	9.5	3.91	17.3	1.09	-3.0
	10/05/75	1506													
	10/05/75	1511													
	10/05/75	2300	3280	540	81.8	26.00	24.30	5.03	35.40	1.75	9.5	4.15	14.2	1.09	-3.9
	10/05/75	2301	3340	410	86.4	25.90	24.70	4.33	35.20	1.55	9.5	4.23	12.3	1.08	-2.8
	10/06/75	0709													
	10/06/75	1500	3680	490	75.4	26.60	23.80	6.05	35.80	1.78	9.2	3.84	16.9	1.09	-2.8
	10/06/75	1501	3640	740	76.3	26.50	23.60	6.20	35.70	1.92	9.2	3.83	17.4	1.10	-3.6

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
628-1D	10/06/75	2300	3040	500	81.8	25.70	22.30	7.03	34.90	2.09	9.3	3.93	20.1	1.11	-5.8
	10/06/75	2306													
	10/06/75	2308													
	10/06/75	2311													
	10/07/75	0700	3840	980	71.7	25.40	22.90	5.88	34.50	2.00	9.2	4.01	17.0	1.11	-5.2
	10/07/75	0701	3840	980	71.7	25.60	22.80	6.30	34.80	2.22	9.2	3.93	18.1	1.12	-6.3
701-1A	10/09/75	2300	2600	360	84.7	28.90	19.80	6.55	31.30	5.74	15.0	5.70	20.9	1.33	-1.2
	10/09/75	2301	2600	360	84.7	28.40	19.50	6.13	30.50	5.62	15.0	5.94	20.1	1.34	-0.4
	10/09/75	2306													
	10/10/75	0700	2440	220	90.0	32.10	17.30	5.78	27.40	9.37	15.9	5.48	21.1	1.62	3.0
	10/10/75	0706													
	10/10/75	2300	3000	320	88.2	32.00	18.10	6.26	28.90	10.25	14.4	4.67	21.7	1.65	-4.1
	10/10/75	2301	3000	320	88.2	32.10	18.30	6.53	29.40	10.19	14.4	4.60	22.2	1.63	-4.6
	10/10/75	2308													
	10/11/75	0700	2920	400	84.8	29.20	21.10	5.73	32.10	5.21	15.0	5.78	17.8	1.30	0.3
	10/11/75	0701	2920	400	84.8	29.20	21.00	5.55	31.80	5.60	15.0	5.73	17.5	1.32	-0.7
	10/11/75	1500	3080	380	86.4	29.30	21.50	5.33	32.20	6.61	15.6	5.81	16.6	1.37	-5.7
	10/11/75	1501	3080	380	66.4	29.30	21.60	4.90	31.90	6.69	15.6	5.85	15.4	1.38	-5.4
	10/11/75	2300	3160	340	88.1	31.00	21.40	4.65	31.40	7.68	16.7	5.92	14.8	1.44	-2.5
	10/11/75	2301	3160	340	88.1	31.00	21.90	4.03	31.40	7.25	16.7	6.07	12.8	1.42	-0.8
	10/12/75	0700	3000	260	90.4	32.10	19.90	7.13	32.00	7.54	18.1	5.84	22.3	1.43	0.2
	10/12/75	0701	3000	260	90.4	32.10	20.20	6.35	31.60	7.60	18.1	5.98	20.1	1.44	0.9
	10/12/75	1500	3040	240	91.3	33.20	23.10	2.73	31.60	8.56	18.6	6.23	8.6	1.49	0.5
	10/12/75	1501	3040	240	91.3	32.90	22.30	3.03	30.90	9.89	18.6	6.10	9.8	1.58	-4.1
	10/12/75	1511													
	10/12/75	2311													
702-1A	10/14/75	2300	3120	600	78.7	29.50	25.00	3.56	34.80	5.39	14.8	5.56	10.2	1.28	-5.9
	10/14/75	2301	3120	600	78.7	29.60	24.80	4.20	35.20	5.94	14.8	5.36	11.9	1.31	-8.9
	10/15/75	0709													
	10/15/75	1500	4060	840	77.1	29.40	27.00	1.86	35.60	5.67	16.8	6.44	5.2	1.29	-9.4
	10/15/75	1501													
	10/15/75	2300	3080	420	84.9	31.00	26.00	1.51	34.00	6.99	14.8	5.44	4.4	1.37	-5.6
	10/15/75	2301	3080	420	84.9	31.00	25.80	1.56	33.80	7.26	14.8	5.39	4.6	1.39	-6.2
	10/15/75	2311													
	10/15/75	2312													
	10/16/75	1500	2840	260	89.9	33.10	23.80	1.95	31.70	9.34	15.9	5.32	6.2	1.54	-3.0
	10/16/75	1501	2840	260	89.9	33.10	23.90	1.83	31.70	9.35	15.9	5.35	5.8	1.54	-3.1
	10/16/75	1508													
	10/16/75	2300	2760	220	91.2	34.70	20.00	3.60	28.60	10.51	14.8	4.67	12.6	1.67	3.7
	10/16/75	2301	2760	220	91.2	34.40	20.10	2.18	27.30	10.40	14.8	5.03	8.0	1.69	5.9
	10/17/75	0500	2920	200	92.4	35.20	20.20	1.65	26.90	11.37	14.7	4.87	6.1	1.77	5.3
703-1A	10/19/75	1100	2440	760	65.5	25.20	25.90	1.93	34.30	2.61	14.1	6.58	5.6	1.14	-8.5
	10/19/75	1500	2490	900	59.8	25.10	27.20	1.51	35.50	2.50	14.3	6.58	4.2	1.13	-11.8
	10/19/75	1900	2920	980	62.8	25.20	27.30	0.78	34.90	1.98	14.6	6.95	2.2	1.10	-7.0
	10/19/75	2300	3120	1000	64.5	24.70	25.90	1.23	33.60	2.37	15.2	7.28	3.7	1.13	-7.5
	10/20/75	0300	2880	820	68.4	24.80	26.00	1.91	34.40	2.26	15.2	7.19	5.5	1.12	-8.8
	10/20/75	1500													
	10/21/75	1500	2520	1200	47.2	23.20	22.50	3.68	31.80	1.27	14.4	7.22	11.8	1.07	-3.0
	10/21/75	1900	2600	940	59.9	20.80	17.50	5.93	27.80	0.78	14.4	7.79	21.3	1.05	1.6
	10/21/75	2300	2400	720	66.6	21.90	20.20	3.95	29.20	0.05	14.8	8.03	13.5	1.00	6.3
	10/22/75	0300	3400	1160	62.2	23.90	21.50	6.23	33.10	0.11	14.9	7.10	18.8	1.01	2.4

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
703-1A	10/22/75	0600	3490	1150	62.4	22.80	20.30	5.33	30.70	2.04	15.5	7.61	17.4	1.12	-5.7
	10/22/75	1500	3920	1740	50.8	22.70	20.80	4.90	30.90	1.09	14.7	7.41	15.9	1.06	-1.5
	10/22/75	1900	3600	1560	52.0	21.00	16.30	7.63	28.00	1.10	15.7	8.19	27.2	1.07	-0.1
	10/22/75	2300	3640	1600	51.3	21.80	19.70	4.78	29.40	0.42	16.4	8.76	16.3	1.03	3.1
	10/23/75	0300	3480	1480	52.8	24.20	25.30	2.58	34.20	1.18	15.7	7.60	7.5	1.06	-5.2
	10/23/75	0700	3880	1660	52.6	23.60	22.70	4.63	33.00	0.98	15.6	7.52	14.0	1.05	-2.4
	10/23/75	1100	3080	1120	59.7	23.50	21.90	4.63	32.00	1.00	15.4	7.57	14.5	1.06	-0.8
	10/23/75	1500	2720	1080	56.0	23.10	21.70	5.88	33.00	0.40	16.0	7.79	17.8	1.02	-2.3
	10/23/75	1900	2560	1100	52.4	24.30	24.70	3.83	34.70	2.22	14.7	6.74	11.0	1.12	-11.7
	10/23/75	2300	2600	1040	55.7	23.20	23.60	1.70	31.20	1.12	14.8	7.67	5.5	1.07	-0.4
	10/24/75	0300	2600	940	59.9	23.00	22.80	2.50	31.00	1.46	15.0	7.74	8.1	1.09	-2.5
	10/24/75	0700	2480	940	58.0	23.70	23.80	2.45	32.20	1.27	14.6	7.34	7.6	1.07	-2.0
	10/24/75	1100	2400	920	57.5	21.20	15.80	7.75	27.50	1.73	14.7	7.57	28.2	1.11	-1.3
	10/24/75	1500	2400	900	58.4	23.40	21.00	5.85	32.10	2.59	14.6	6.84	18.2	1.15	-10.2
	10/24/75	1900	2640	1080	54.6	23.50	21.50	6.03	32.90	2.42	14.3	6.64	18.3	1.13	-11.2
	10/24/75	2300	2800	1140	54.9	21.90	19.50	4.53	28.90	3.23	14.7	7.44	15.7	1.20	-11.2
	10/25/75	0300	2800	1000	60.4	22.50	20.80	4.00	30.00	1.03	15.2	7.92	13.3	1.06	0.8
	10/25/75	0700	2800	1020	59.6	20.50	14.30	8.53	26.40	1.97	15.2	7.96	32.3	1.14	-2.5
	10/25/75	1100	2480	900	59.8	20.60	14.30	8.83	26.70	1.95	15.2	7.88	33.1	1.13	-2.9
	10/25/75	1500	2200	840	57.7	22.10	21.70	3.18	30.30	0.99	15.5	8.24	10.5	1.06	-1.7
	10/25/75	1900	2120	780	59.2	22.10	18.90	6.18	29.80	1.38	14.5	7.32	20.7	1.08	-2.4
	10/25/75	2300	2520	780	65.7	21.30	18.40	3.70	26.70	2.64	15.0	8.14	13.9	1.18	-3.6
	10/26/75	0302	3120	1160	58.8	19.00				1.76	14.2	8.86			
	10/26/75	0700	3080	1120	59.7	24.80	18.70	10.03	33.40	1.14	14.9	6.38	30.0	1.06	-0.2
	10/26/75	1100	2800	900	64.4	22.20	11.90	13.43	28.30	2.30	16.0	7.27	47.4	1.15	-2.5
	10/26/75	1500	3160	1200	57.9	21.00	17.00	5.75	27.00	1.98	15.4	8.26	21.3	1.13	-2.1
	10/26/75	1900	3280	1200	59.4	22.00	17.40	6.85	28.60	0.11	14.9	7.80	24.0	1.01	8.3
	10/26/75	2300	3600	1180	63.7	23.10	20.10	3.78	28.90	1.49	15.0	7.80	13.1	1.09	4.1
	10/27/75	0300	3680	1280	61.4	23.40	21.50	2.93	29.80	1.59	15.2	7.83	9.8	1.10	2.1
	10/27/75	0700	3720	1260	61.9	24.30	22.40	3.80	31.80	1.87	15.5	7.46	12.0	1.11	-1.5
	10/27/75	1100	3880	1660	52.6	23.60	23.50	2.43	31.80	1.98	15.1	7.54	7.6	1.11	-5.1
	10/27/75	1500	3320	1240	58.6	23.90	22.40	4.20	32.20	0.94	15.0	7.38	13.1	1.05	0.6
	10/27/75	1900	3120	1120	60.2	23.60	21.30	4.88	31.50	1.54	14.7	7.18	15.5	1.09	-1.8
	10/27/75	2300	3320	1400	53.2	23.70	22.90	3.58	32.20	2.48	15.2	7.33	11.1	1.14	-8.5
	10/28/75	0300	3280	1400	52.7	23.30	23.40	1.85	31.10	1.16	15.2	7.93	6.0	1.07	0.2
	10/28/75	0700	3280	960	67.6	24.30	22.00	3.50	31.00	2.47	16.4	7.97	11.3	1.14	-2.3
	10/28/75	1100	3120	1060	62.3	23.60	22.80	2.40	30.90	2.16	12.5	6.32	7.8	1.13	-3.4
	10/28/75	1500	3080	1220	56.1	23.60	23.10	3.23	32.10	0.11	14.8	7.57	10.1	1.01	4.1
	10/28/75	1900	3080	1260	54.6	23.70	23.00	3.45	32.20	0.22	14.8	7.46	10.7	1.01	3.6
	10/28/75	2300	3000	1400	48.3	22.30	21.60	2.80	29.80	0.17	15.2	8.25	9.4	1.01	5.4
	10/29/75	0300	3040	1300	52.6	22.50	21.80	2.45	29.70	0.90	15.4	8.25	8.3	1.06	2.4
	10/29/75	0700	3200	1260	56.3	22.80	22.30	2.23	30.10	0.55	15.1	8.05	7.4	1.03	4.5
	10/29/75	1100	3320	1340	55.2	23.30	22.50	2.68	30.80	0.70	15.2	7.92	8.7	1.04	3.6
	10/29/75	1500	3280	1160	60.8	23.20	21.00	2.55	28.80	0.90	16.0	8.54	8.9	1.06	8.1
	10/29/75	1900	3200	1220	57.7	22.90	21.90	3.43	30.80	2.20	14.3	7.23	11.1	1.13	-6.5
	10/29/75	2300	3200	1200	58.4	20.20	17.20	8.50	30.00	0.85	15.2	7.37	28.3	1.05	-9.4
	10/30/75	0300	3640	1600	51.3	18.20	11.50	7.33	21.70	0.62	15.6	9.42	33.8	1.05	12.1
	10/30/75	0700	3440	1300	58.1	23.00	22.50	1.98	30.10	0.50	15.4	9.21	6.6	1.03	5.6
	10/30/75	1100	3400	1200	60.9	22.20	20.50	2.98	28.60	1.23	14.9	9.05	10.4	1.08	2.7
	10/30/75	1500	3000	1240	54.2	23.20	21.50	4.93	31.80	0.22	15.4	7.89	15.5	1.01	2.8
	10/30/75	1900	3040	1180	57.0	22.90	21.80	3.55	30.80	0.96	14.9	7.69	11.5	1.06	0.4

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
703-1A	10/30/75	2300	3080	1160	57.5	21.10	17.00	5.85	27.10	1.64	15.0	8.02	21.6	1.11	0.1
	10/31/75	0700													
	10/31/75	1500													
	11/01/75	0300	4220	1620	52.2	21.80	18.80	5.10	28.60	1.47	15.5	8.15	17.8	1.09	-0.5
	11/01/75	0700	3880	1680	52.0	21.90	19.70	4.28	28.90	1.27	17.3	9.18	14.8	1.08	0.2
	11/01/75	1100	3200	1200	58.4	21.30	17.90	5.53	27.90	1.60	15.5	8.19	19.8	1.10	-1.3
	11/01/75	1500	2940	1120	57.6	22.40	21.90	2.83	30.20	1.83	15.4	8.04	9.4	1.11	-4.8
	11/01/75	1900	2600	1000	57.4	21.40	19.00	4.25	28.00	1.13	15.5	8.45	15.2	1.07	1.6
704-1A	11/03/75	2300	2800	560	77.9	23.40	20.80	2.80	28.80	2.18	14.9	7.73	9.7	1.14	1.9
	11/04/75	0300	2560	420	81.8	24.70	20.20	3.45	28.70	3.10	15.4	7.56	12.0	1.20	2.6
	11/04/75	0700	2840	480	81.3	25.50	20.50	2.78	28.40	3.87	15.5	7.47	9.8	1.25	2.6
	11/04/75	1100	2920	420	84.1	26.00	18.50	4.18	27.30	4.83	15.5	7.20	15.3	1.32	2.8
	11/04/75	1500	2920	380	85.6	26.60	18.00	3.50	26.00	5.50	15.2	7.08	13.5	1.38	5.2
	11/04/75	1900	2960	380	85.8	26.10	18.20	3.35	26.10	5.54	14.9	7.02	12.8	1.39	2.9
	11/04/75	2300	3380	460	84.9	28.90	14.70	5.93	24.30	11.15	14.4	5.49	24.4	1.83	-8.1
	11/04/75	2307													
	11/05/75	0300	4180	600	84.1	29.90	14.70	6.73	25.10	8.37	15.2	5.87	26.8	1.61	5.5
	11/05/75	0700	4000	500	86.2	31.00	16.60	6.05	26.80	10.10	15.8	5.54	22.6	1.69	-2.1
	11/05/75	1100	3600	340	89.6	32.00	16.30	6.23	26.60	10.04	15.4	5.30	23.4	1.69	1.8
	11/05/75	1500	3680	340	89.8	32.60	17.90	5.83	28.20	8.87	15.6	5.33	20.7	1.57	4.7
	11/05/75	1900	3480	320	89.8	32.30	17.00	5.85	27.10	8.89	15.9	5.56	21.6	1.60	6.2
	11/05/75	2300	3840	420	87.9	32.90	14.50	11.98	30.10	10.45	15.9	4.17	39.8	1.63	-4.6
	11/06/75	0300	4400	540	86.4	32.80	14.00	12.90	30.40	10.08	16.2	4.17	42.4	1.60	-4.1
	11/06/75	0700	4120	560	85.0	33.50	20.90	2.68	28.80	9.31	16.3	5.65	9.3	1.59	4.4
	11/06/75	1100	3720	340	89.9	33.70	20.80	3.20	29.20	9.65	15.8	5.30	11.0	1.60	2.8
	11/06/75	1500													
	11/06/75	1530	3660	360	89.1	33.30	22.00	2.80	30.30	10.40	14.9	4.88	9.3	1.62	-3.5
	11/06/75	1900	3080	380	86.4	30.20	16.10	5.08	25.20	10.46	13.8	5.17	20.2	1.76	-2.6
	11/06/75	2300	2840	460	82.1	27.50	24.90	3.28	34.40	4.47	13.8	5.65	9.5	1.24	-8.3
	11/07/75	0500	3160	500	82.5	28.10	27.10	2.63	36.50	2.81	15.5	6.41	7.2	1.14	-3.7
705-1A	11/07/75	1900	2880	700	73.1	27.60	19.40	2.35	26.60	5.02	14.2	6.63	8.8	1.34	9.3
	11/07/75	2300	3000	760	71.9	31.50	25.40	1.06	32.80	1.77	14.3	6.08	3.2	1.10	19.9
	11/08/75	0300	3000	640	76.4	31.30	24.30	4.03	34.40	2.69	15.0	5.82	11.7	1.14	12.1
	11/08/75	0700	3040	520	81.1	30.50	23.60	3.00	32.50	2.86	16.1	6.68	9.2	1.16	13.4
	11/08/75	1100	3040	460	83.3	31.30	22.70	1.43	29.80	4.21	15.8	6.67	4.8	1.26	16.2
	11/08/75	1500	2840	380	85.2	33.00	23.40	3.25	32.50	4.46	15.6	5.79	10.0	1.25	13.8
	11/08/75	1900	3280	580	80.4	29.70	21.60	0.40	27.40	4.91	15.3	7.02	1.5	1.33	14.3
	11/08/75	2300	2960	500	81.3	32.20	24.90	3.68	34.80	3.94	14.9	5.46	10.6	1.21	8.7
	11/09/75	0300	2920	480	81.8	31.10	23.20	6.20	35.20	3.88	14.4	5.09	17.6	1.20	4.8
	11/09/75	0700	3080	440	84.2	30.20	25.70	2.58	35.10	3.08	14.7	5.82	8.5	1.16	5.6
	11/09/75	1100	3160	560	80.4	29.50	25.80	1.76	34.00	3.19	14.5	6.08	5.2	1.17	5.5
	11/09/75	1500	3080	540	80.6	32.10	23.40	6.85	36.10	4.91	14.6	4.70	19.0	1.25	1.7
	11/09/75	1900	3000	480	82.3	33.60	18.90	9.18	31.80	5.93	15.0	4.78	25.7	1.34	11.2
	11/09/75	2300	3040	460	83.3	32.20	26.20	3.16	35.90	3.09	15.0	5.49	8.8	1.16	9.7
	11/10/75	0300	3120	480	83.0	32.40	25.00	6.96	38.20	2.97	15.3	4.95	18.2	1.14	5.7
	11/10/75	0700	3120	420	85.1	28.10	23.70	1.98	31.60	4.55	13.9	6.02	6.3	1.26	0.6
	11/10/75	1100	2960	320	88.1	28.70	23.10	4.43	33.30	6.09	15.4	5.89	13.3	1.33	-8.3
	11/10/75	1500	2960	400	85.1	29.80	26.30	0.83	33.70	4.74	15.2	6.38	2.5	1.26	-2.9
	11/10/75	1900	3320	520	82.7	27.80	22.70	4.13	32.50	6.32	15.0	5.97	12.7	1.35	-10.9
	11/10/75	2300	3520	580	81.8	28.80	25.60	4.71	36.70	4.22	15.3	5.71	12.8	1.21	-7.9
	11/11/75	0300	3640	640	80.5	31.60	27.90	1.53	36.40	3.96	15.3	5.73	4.2	1.20	3.3

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RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
705-1A	11/11/75	0700	3920	780	78.0	23.40	20.30	2.23	27.60	3.88	15.6	6.52	8.1	1.26	-3.7
	11/11/75	1100	3880	720	79.5	28.90	26.00	2.81	35.30	4.60	15.2	6.02	7.9	1.24	-5.8
	11/11/75	1500	3690	580	82.6	29.00	24.10	1.68	31.80	6.15	15.3	6.26	5.3	1.35	-3.8
	11/11/75	1900	3640	620	81.1	27.40	24.20	0.95	31.20	6.94	14.7	6.21	3.1	1.40	-10.4
	11/11/75	2300	3840	640	81.6	28.80	26.90	2.18	35.80	5.50	15.1	5.85	6.1	1.28	-11.4
	11/12/75	0300	3960	620	82.7	28.30	26.80	1.01	34.50	4.81	15.2	6.33	2.9	1.25	-7.1
	11/12/75	0700	3840	600	82.7	27.40	23.80	1.55	31.30	7.47	15.1	6.28	5.0	1.43	-14.8
	11/12/75	1100	3290	380	87.2	26.80	21.30	1.48	28.10	8.67	14.7	6.38	5.3	1.56	-14.7
	11/12/75	1500	2800	320	87.4	28.00	22.10	1.58	29.20	8.06	15.1	6.23	5.4	1.50	-9.7
	11/12/75	1900	2840	360	86.0	25.30	18.00	0.80	23.30	10.72	14.3	6.65	3.4	1.84	-18.5
	11/12/75	2300	2840	340	86.8	28.90	22.80	3.70	32.20	3.98	14.2	5.88	11.5	1.22	4.4
	11/13/75	0300	2600	260	89.0	29.40	23.20	4.30	33.30	6.45	14.3	5.33	12.9	1.35	-7.3
	11/13/75	0700	2480	260	88.4	25.80	18.80	8.50	32.00	6.71	14.7	5.68	26.6	1.38	-20.0
706-1A	11/13/75	2300	2960	740	72.3	26.30	23.10	5.53	34.40	3.20	12.9	5.37	16.1	1.17	-7.1
	11/14/75	0300	3080	720	74.1	27.30	25.50	2.93	34.80	2.84	12.9	5.56	8.4	1.15	-2.5
	11/14/75	0700	3080	640	77.0	26.20	20.10	5.08	30.20	5.45	14.7	6.32	16.8	1.33	-7.2
	11/14/75	1100	3290	620	78.5	26.50	19.70	5.88	30.50	5.30	14.2	5.97	19.3	1.32	-6.1
	11/14/75	1500	3520	940	70.4	27.70	19.80	10.25	35.00	3.57	14.5	5.25	29.3	1.19	-4.9
	11/14/75	1900	3600	690	79.1	28.40	21.30	7.78	34.40	4.72	15.0	5.51	22.6	1.25	-6.0
	11/14/75	2300	3600	660	79.7	28.10	20.50	6.18	31.80	4.77	14.2	5.64	19.4	1.27	-0.9
	11/15/75	0300	3280	560	81.1	28.00	20.30	7.63	33.00	3.98	14.4	5.56	23.1	1.22	-0.7
	11/15/75	0700	3100	500	82.1	27.50	20.10	6.28	31.40	3.54	14.7	6.14	20.0	1.21	3.6
	11/15/75	0707													
	11/15/75	0710													
	11/15/75	1100	3100	480	82.9	27.30	19.70	6.28	30.90	5.27	14.1	5.76	20.3	1.31	-3.9
	11/15/75	1500	2840	640	75.0	27.10	24.90	5.08	36.20	1.52	13.9	5.86	14.0	1.08	-0.7
	11/15/75	1900	2880	1000	61.5	25.30	23.30	6.68	35.80	1.37	13.2	5.68	18.7	1.07	-6.0
	11/15/75	2300	2840	700	72.7	26.10	23.70	6.18	35.80	2.92	13.3	5.45	17.3	1.15	-10.3
	11/16/75	0300	2920	520	80.3	26.10	23.20	7.20	36.20	2.56	13.7	5.51	19.9	1.13	-9.8
	11/16/75	0700	3000	820	69.7	24.90	21.00	7.25	33.50	2.04	14.7	6.42	21.7	1.11	-4.7
	11/16/75	0707													
	11/16/75	1100	3400	860	72.0	24.20	19.60	6.30	30.80	3.19	15.5	7.13	20.5	1.19	-5.9
	11/16/75	1500	3440	1460	52.9	25.30	25.50	5.83	37.70	0.83	14.5	6.10	15.5	1.04	-6.0
	11/16/75	1900	3760	1460	56.9	22.70	20.00	5.90	30.90	1.08	14.1	7.03	19.1	1.06	-1.4
	11/16/75	2300	3720	1480	55.9	23.50	21.40	5.85	32.60	1.05	14.6	7.02	18.0	1.06	-2.9
	11/17/75	0300	3520	1360	57.2	23.70	22.70	4.43	32.80	0.83	15.0	7.30	13.5	1.05	-1.4
	11/17/75	0700	3360	1280	57.9	24.10	20.90	6.98	33.10	1.13	15.5	7.19	21.1	1.06	-2.2
	11/17/75	1100	3640	1490	54.9	24.50	24.00	4.30	34.30	0.85	14.6	6.88	12.6	1.05	-2.5
	11/17/75	1500	3060	1180	57.5	23.00	20.00	6.90	31.90	1.25	14.5	6.96	21.6	1.07	-4.1
	11/17/75	1900	3080	1200	56.8	22.30	16.40	7.30	30.30	1.31	15.2	7.50	24.1	1.08	-2.7
	11/17/75	2300	3000	1060	60.8	23.40	20.70	6.53	32.40	1.27	15.0	7.09	20.2	1.07	-3.9
	11/18/75	0300	2960	1100	58.8	23.30	21.00	6.05	32.30	1.21	14.8	7.14	18.7	1.07	-3.7
	11/18/75	0700	2800	940	61.2	24.30	24.40	3.20	33.70	1.58	14.7	7.05	9.5	1.09	-5.4
	11/18/75	1100	2720	900	63.1	24.70	23.50	5.23	34.60	1.04	14.2	6.50	15.1	1.05	-3.5
	11/18/75	1500	2560	940	59.3	24.50	22.10	6.66	34.30	0.47	13.4	6.14	19.5	1.02	-0.5
	11/18/75	1900	2920	1200	54.4	24.20	22.50	6.08	34.20	0.74	13.7	6.33	17.8	1.04	-2.9
	11/18/75	2300	3440	1440	53.6	22.80	19.20	7.30	31.30	1.14	14.6	7.07	23.3	1.07	-2.5
	11/19/75	0300	3360	1240	57.9	23.30	19.50	7.63	32.00	1.83	14.2	6.56	23.8	1.10	-6.2
	11/19/75	0700	3840	1460	57.8	24.00	23.30	4.18	33.30	1.47	14.9	7.15	12.6	1.08	-5.0
	11/19/75	1100	3490	1240	60.5	21.10	19.40	5.95	29.20	1.93	14.6	7.90	14.0	1.12	-5.3
	11/19/75	1500	2920	1140	56.7	23.40	21.90	5.73	33.10	0.92	14.9	7.11	17.3	1.05	-4.1

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
706-1A	11/19/75	1900	2960	1140	57.3	22.60	19.20	7.60	31.60	1.03	14.2	6.83	24.1	1.06	-3.7
	11/19/75	2300	2880	1140	56.1	22.90	19.30	7.58	31.70	1.03	14.3	6.83	23.9	1.06	-2.7
	11/19/75	2307													
	11/19/75	2310													
	11/19/75	2311													
	11/20/75	0300	2480	1040	53.5	22.50	18.00	8.70	31.20	1.13	14.0	6.71	27.9	1.07	-3.5
	11/20/75	0700	2600	1080	53.9	23.00	21.30	4.98	31.60	1.32	14.0	6.91	15.8	1.08	-3.6
	11/20/75	1100	2600	960	59.1	21.80	18.30	6.53	29.40	1.60	14.6	7.42	22.2	1.10	-3.8
	11/20/75	1500	2640	1040	56.3	21.50	17.90	6.33	28.70	1.31	14.8	7.70	22.1	1.08	-1.3
	11/20/75	1510													
	11/20/75	1900	2760	1060	57.4	22.60	19.50	5.53	29.90	1.31	15.2	7.72	18.5	1.08	-0.1
	11/20/75	2300	3280	1320	55.4	22.10	20.20	3.95	29.20	0.54	15.4	8.24	13.5	1.03	4.3
	11/20/75	2307													
	11/20/75	2310													
	11/21/75	0300	3600	1420	56.3	22.50	20.50	4.36	30.00	0.38	15.9	8.35	14.6	1.02	4.5
	11/21/75	0700	3800	1400	59.2	20.50	19.50	2.43	26.80	1.16	16.4	9.43	9.1	1.08	1.2
	11/21/75	0707													
	11/21/75	0710													
707-1A	11/21/75	1900	3900	1120	68.2	24.40	22.40	3.70	31.70	2.09	16.3	7.84	11.7	1.12	-1.9
	11/21/75	2300	4040	1060	70.9	24.80	21.60	3.00	30.00	3.30	15.7	7.56	10.0	1.20	-1.7
	11/22/75	0300	3920	1000	71.7	25.70	21.80	3.35	30.60	3.91	14.5	6.60	11.0	1.23	-2.8
	11/22/75	0700	3960	920	74.3	27.60	24.00	2.60	32.60	5.01	14.3	6.02	8.0	1.28	-5.9
	11/22/75	1100	4040	880	75.9	26.30	22.60	0.45	28.70	5.83	15.1	7.14	1.6	1.37	-4.7
	11/22/75	1500	3880	720	79.5	28.60	22.70	4.53	32.90	5.67	15.6	6.10	13.8	1.31	-5.8
	11/22/75	1900	3640	600	81.9	29.40	21.00	6.55	32.80	6.68	15.3	5.47	20.0	1.37	-7.1
	11/22/75	2300	3400	560	81.8	29.20	22.80	3.80	32.30	6.58	14.9	5.69	11.5	1.37	-6.2
	11/23/75	0300	3400	540	82.4	27.90	24.10	0.78	30.90	6.71	14.7	6.29	2.5	1.40	-8.2
	11/23/75	0700	3200	480	83.4	30.00	23.70	2.08	31.70	7.15	14.5	5.62	6.6	1.41	-4.4
	11/23/75	1100	3320	520	82.7	30.00	20.10	6.38	31.50	8.69	15.0	5.09	20.3	1.50	-10.5
	11/23/75	1500	3360	540	82.2	30.80	24.30	4.23	34.60	6.05	15.2	5.35	12.2	1.32	-3.7
	11/23/75	1900	3800	660	80.8	30.00	23.20	4.50	33.50	5.94	15.4	5.68	13.4	1.32	-3.4
	11/23/75	2300	4170	780	79.3	29.30	21.20	4.50	31.00	7.15	15.5	5.92	14.5	1.42	-5.2
	11/24/75	0300	4200	820	78.4	29.60	20.80	6.80	32.80	7.26	15.4	5.37	20.7	1.40	-8.9
	11/24/75	0700	4340	760	80.6	30.10	26.00	2.21	34.70	5.75	16.2	6.17	6.4	1.30	-5.1
	11/24/75	1100	4400	820	79.4	30.00	24.80	3.30	34.30	6.91	15.8	5.74	9.6	1.37	-9.4
	11/24/75	1500	4300	780	79.9	30.10	25.00	3.46	34.70	6.11	16.0	5.84	10.0	1.32	-6.6
	11/24/75	1900	3820	620	82.0	29.60	24.00	3.00	33.00	6.05	16.0	6.16	9.1	1.33	-4.1
	11/24/75	2300	3520	540	83.0	28.90	18.00	7.20	29.70	8.31	15.5	5.62	24.3	1.51	-8.6
	11/25/75	0300	3560	590	82.0	29.10	22.60	3.25	31.50	7.10	16.3	6.37	10.3	1.41	-6.9
	11/25/75	0700	3120	440	84.4	27.70	23.10	1.53	30.40	6.66	15.7	6.73	5.0	1.40	-7.5
	11/25/75	1100	2800	400	84.2	29.40	23.80	3.05	32.80	6.49	14.9	5.75	9.3	1.36	-6.3
	11/25/75	1500	2680	440	81.8	29.10	23.50	4.13	33.50	5.50	14.6	5.61	12.3	1.30	-4.7
	11/25/75	1900	2960	560	79.1	28.80	23.40	3.95	33.20	4.29	14.6	5.90	11.9	1.24	0.3
	11/25/75	2300	2920	480	81.8	28.20	22.80	3.00	31.50	6.77	14.6	5.88	9.5	1.39	-8.8
	11/26/75	0300	3000	500	81.6	28.70	23.90	2.63	32.50	5.78	14.6	5.90	8.1	1.32	-5.0
	11/26/75	0700	3000	440	83.8	28.80	23.20	2.60	31.60	6.66	14.8	5.90	9.2	1.38	-6.3
	11/26/75	1100	3080	480	82.8	29.10	23.30	3.88	33.00	6.33	14.4	5.51	11.8	1.35	-7.2
708-1A	11/26/75	1500	3080	460	83.5	29.20	23.90	3.43	33.30	5.28	14.7	5.75	10.3	1.29	-2.9
	11/26/75	1900	2840	380	85.2	27.20	24.20	1.05	31.30	5.17	14.8	6.59	3.4	1.30	-4.8
	11/26/75	2300	2800	340	86.6	29.60	22.40	5.30	33.30	7.21	14.7	5.21	15.9	1.39	-9.8
	11/27/75	0300	2880	380	85.4	29.10	20.20	7.75	33.00	6.66	14.5	5.08	23.5	1.37	-8.6

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
708-1A	11/27/75	0700	2800	400	84.2	29.30	20.30	6.83	32.20	6.64	14.2	5.14	21.2	1.38	-5.9
	11/27/75	1100	2760	400	84.0	29.20	20.80	8.20	34.20	4.58	14.3	5.11	24.0	1.24	-2.0
	11/27/75	1500	2320	320	84.7	28.50	18.00	10.00	32.50	5.78	14.0	5.85	30.8	1.32	-5.7
	11/27/75	1900	2360	440	79.4	28.20	21.30	4.58	31.20	6.77	13.9	5.47	14.7	1.39	-8.1
	11/27/75	2300	3360	820	73.0	27.40	21.00	5.05	31.30	5.78	14.4	5.88	16.1	1.34	-6.9
	11/28/75	0300	3680	900	72.9	27.30	23.10	4.73	33.60	4.79	14.8	6.00	14.1	1.26	-8.6
	11/28/75	0700	3560	800	75.1	26.80	21.30	5.78	32.40	5.29	14.7	5.95	17.8	1.30	-9.8
	11/28/75	1100	3040	640	76.7	27.80	21.70	6.78	33.90	3.16	14.8	5.89	20.0	1.17	0.1
	11/28/75	1500	2800	680	73.1	27.20	23.60	4.90	34.40	3.05	14.5	6.05	14.3	1.16	-2.9
	11/28/75	1900	2690	680	71.9	26.20	23.20	4.40	33.40	3.17	14.4	6.28	13.2	1.17	-4.7
	11/28/75	2300	2720	680	72.3	26.10	22.00	5.50	33.00	4.24	14.8	6.22	16.7	1.23	-9.3
	11/29/75	0300	2800	700	72.3	26.80	25.10	3.73	35.10	3.47	13.9	5.84	10.6	1.18	-8.2
	11/29/75	0700	2800	700	72.3	26.40	21.20	8.40	34.90	3.11	14.3	5.68	24.1	1.16	-7.6
	11/29/75	1100	2600	600	74.4	26.40	20.80	8.30	34.30	2.90	14.3	5.75	24.2	1.15	-5.0
	11/29/75	1500	2780	740	70.5	26.40	24.80	3.90	34.90	2.34	14.9	6.47	11.2	1.12	-3.9
	11/29/75	1900	2720	640	72.3	24.90	21.70	4.08	31.20	2.94	15.6	7.31	13.1	1.17	-2.8
	11/29/75	2300	3400	1020	66.8	25.80	22.90	5.48	34.10	3.41	15.3	6.52	16.1	1.18	-9.4
	11/30/75	0300	3920	1400	60.4	25.40	22.10	6.58	34.20	2.81	14.8	6.31	19.2	1.15	-8.4
	11/30/75	0700	4150	1460	60.5	25.30	26.10	2.48	35.10	1.23	15.0	7.01	7.1	1.06	-3.4
	11/30/75	1100	3960	1380	61.4	23.60	20.40	5.70	31.20	0.84	15.1	7.98	18.3	1.05	2.9
	11/30/75	1500	3960	1300	63.6	25.10	26.20	1.36	34.10	2.15	15.0	7.11	4.0	1.11	-6.1
	11/30/75	1900	3920	1110	68.6	24.30	24.00	3.00	33.00	2.42	15.3	7.25	9.1	1.13	-7.8
	11/30/75	2300	3480	700	77.7	24.60	20.80	5.40	31.40	3.25	15.5	7.14	17.2	1.19	-6.2
	12/01/75	0300	4140	960	74.3	25.70	22.80	3.40	31.90	3.80	15.1	6.85	10.7	1.22	-5.8
	12/01/75	0700	4040	900	75.3	26.20	23.90	2.63	32.50	3.04	15.4	7.02	8.1	1.17	-1.7
	12/01/75	0701	4020	690	75.5	27.40	22.10	4.98	32.60	4.66	14.7	6.01	15.3	1.25	-5.0
	12/01/75	1100	3840	800	76.9	26.30	23.30	2.48	31.60	4.16	14.9	6.77	7.8	1.24	-4.3
	12/01/75	1500	3600	800	75.4	26.20	22.40	5.10	33.10	2.80	15.4	7.23	15.4	1.15	-2.1
	12/01/75	1900	3720	880	73.8	25.60	22.30	3.93	31.80	3.26	15.0	6.82	12.4	1.19	-3.2
	12/01/75	2300	3680	900	72.9	25.50	24.20	1.45	31.70	3.30	14.7	7.01	4.6	1.19	-3.6
	12/02/75	0300	3400	760	75.2	25.70	22.60	3.35	31.60	3.47	14.2	6.51	10.6	1.20	-3.3
	12/02/75	0700	3320	700	76.6	26.40	25.30	2.08	33.70	3.08	14.4	6.48	6.2	1.17	-4.3
709-1A	12/06/75	1900	3160	760	73.4	25.80	21.40	4.45	31.20	4.90	12.5	5.49	14.3	1.29	-8.9
	12/06/75	2300	3460	840	73.1	26.80	22.70	3.23	31.60	3.76	13.4	5.97	10.2	1.22	-0.5
	12/07/75	0300	3480	760	75.8	27.00	22.50	3.78	31.90	4.04	14.8	6.47	11.8	1.23	-1.8
	12/07/75	0700	3400	720	76.5	26.90	20.60	4.75	30.50	5.12	15.1	6.46	15.6	1.31	-3.7
	12/07/75	1100	3320	700	76.6	26.80	21.30	4.28	30.90	5.23	14.8	6.33	13.8	1.31	-5.6
	12/07/75	1500	3760	1000	70.5	26.50	21.60	4.50	31.50	4.84	14.4	6.16	14.3	1.28	-6.5
	12/07/75	1900	4160	1040	72.3	26.60	21.50	4.73	31.60	4.95	15.5	6.53	15.0	1.28	-6.9
	12/07/75	2300	4130	860	76.9	27.40	20.10	5.88	31.00	5.59	15.1	6.13	19.0	1.33	-5.2
	12/08/75	0300	4110	800	78.4	27.50	20.20	6.45	31.70	5.84	15.9	6.25	20.4	1.34	-7.8
	12/08/75	0700	4400	960	75.9	28.00	20.60	4.55	30.30	6.16	16.6	6.76	15.0	1.37	-3.8
	12/08/75	1100	4470	840	79.2	28.80	21.20	5.10	31.60	6.22	16.0	6.19	16.2	1.36	-4.4
	12/08/75	1500	4290	760	80.0	29.10	23.60	2.70	32.20	5.03	15.3	6.16	8.4	1.28	0.5
	12/08/75	1900	4130	760	79.6	29.10	22.80	3.20	31.70	6.69	14.7	5.73	10.1	1.39	-5.6
	12/08/75	2300	3800	650	81.1	29.10	21.60	4.20	31.20	7.50	14.8	5.64	13.5	1.44	-7.9
	12/09/75	0300	3800	720	79.0	29.30	22.90	3.78	32.40	6.47	15.1	5.76	11.7	1.36	-5.6
	12/09/75	0700	3160	480	83.2	29.30	20.30	5.83	31.20	9.16	14.5	5.07	18.7	1.53	-14.4
	12/09/75	1100	3120	480	83.0	29.70	19.70	4.38	29.00	9.57	14.4	5.29	15.1	1.60	-9.5
	12/09/75	1500	2920	420	84.1	30.20	24.70	3.63	34.50	6.27	14.5		10.5	1.33	-6.5
	12/09/75	1900	2960	400	85.1	30.20	23.10	5.03	33.90	7.37	15.0		14.9	1.40	-9.7

-SOLID ANALYSES AT SCRUBBER INLET-

BLK NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSCLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
709-1A	12/09/75	2300	3480	520	83.5	30.00	19.90	7.33	32.20	8.20	15.3		22.8	1.46	-10.0
	12/10/75	0300	3660	620	81.2	29.30	22.70	5.33	33.70	6.99	15.8		15.8	1.38	-11.0
	12/10/75	0700	3480	640	79.6	28.60	26.10	2.28	34.90	3.60			6.5	1.19	-1.5
	12/10/75	1100	3620	700	78.6	28.80	21.20	5.90	32.40	5.49	15.2		18.2	1.31	-3.1
	12/10/75	1500	3320	560	83.3	28.50	22.70	5.53	33.90	6.54	16.1		16.3	1.35	-12.6
	12/10/75	1900	3280	460	84.5	29.30	22.70	5.63	34.00	6.43	15.7		16.6	1.34	-9.2
	12/10/75	2300	3320	460	84.7	29.10	23.60	2.00	31.50	6.00	15.1		6.4	1.35	-2.1
	12/11/75	0300	3320	460	84.7	29.40	23.50	3.63	33.00	6.44	15.1		11.0	1.36	-6.5
	12/11/75	0700	3920	660	81.4	30.30	25.90	5.23	37.60	4.30	15.3		13.9	1.21	-5.0
	12/11/75	1100	3800	660	80.2	27.70	19.20	6.90	30.90	6.65	15.0		22.3	1.39	-8.7
	12/11/75	1500	3520	620	80.5	30.40	25.10	4.53	35.90	6.33	15.2	5.23	12.6	1.32	-9.3
	12/11/75	1537													
	12/11/75	1900	3520	600	81.1	29.20	22.80	4.80	33.30	6.00	14.9	5.58	14.4	1.33	-6.1
	12/11/75	2300	3320	600	80.0	28.90	22.20	3.25	31.00	6.82	15.1	5.98	10.5	1.40	-5.2
	12/11/75	2301	3340	600	80.1	29.20	22.20	3.15	30.90	6.82	15.1	5.96	10.2	1.40	-3.9
	12/11/75	2307													
	12/12/75	0300	3000	480	82.3	28.80	22.30	4.03	31.90	6.82	15.0	5.81	12.6	1.39	-7.8
	12/12/75	0700	2860	460	82.2	26.90	20.00	1.90	26.90	5.48	14.9	6.99	7.1	1.37	4.0
	12/12/75	0707													
	12/12/75	1500	3480	680	78.4	31.40	24.40	7.20	37.70	4.58	14.3	4.56	19.1	1.22	-2.7
710-1A	12/12/75	1500													
	12/12/75	1601	3580	730	77.4	28.80	24.30	1.53	31.90	4.58	14.3	6.06	4.8	1.26	2.1
	12/12/75	1900	3720	780	76.8	29.60	19.40	11.55	35.80	5.79	14.2	4.32	32.3	1.29	-9.6
	12/12/75	2300	3720	740	78.0	26.80	20.60	1.15	26.90	6.55	16.1	7.53	4.3	1.44	-1.5
	12/13/75	0300	3760	620	81.7	27.40	17.30	4.08	25.70	8.42	17.4	7.44	15.9	1.60	-4.9
	12/13/75	0700	3880	620	82.3	29.60	21.90	6.13	33.50	7.15	17.1	5.97	18.3	1.39	-10.1
	12/13/75	1100	3600	480	85.3	29.90	20.70	8.53	34.40	7.05	15.8	5.10	24.8	1.37	-10.6
	12/13/75	1500													
	12/13/75	1501	3440	500	83.9	29.80	22.00	2.00	29.50	7.58			6.8	1.47	-1.8
	12/13/75	1502	3400	480	84.4	29.10	21.90	9.73	37.10	7.58	15.3	4.53	26.2	1.37	-22.5
	12/13/75	1900	3480	500	84.1	29.40	21.80	8.35	35.60	7.54	15.5	4.89	23.5	1.39	-17.5
	12/13/75	2300	3400	480	84.4	28.30	20.30	2.13	27.50	8.14	16.0	6.84	7.7	1.54	-4.7
	12/13/75	2301	3460	470	85.0	30.00	20.20	4.95	30.20	8.14	16.0	5.86	16.4	1.49	-5.1
	12/14/75	0300	3280	460	84.5	29.90	20.50	1.18	26.80	9.02	16.0	6.54	4.4	1.61	-1.2
	12/14/75	0700	3840	680	80.4	28.50	20.40	3.80	29.30	8.09	16.1	6.38	13.0	1.50	-8.2
	12/14/75	1100	3360	580	80.9	27.00	18.40	4.00	27.00	9.19	16.0	6.67	14.8	1.62	-13.4
	12/14/75	1500	3400	560	81.8	26.50	21.40	4.55	31.30	7.23	16.0	6.50	14.6	1.42	-17.5
	12/14/75	1501	3400	550	82.1	29.90	21.40	4.45	31.20	7.23			14.3	1.42	-3.9
	12/14/75	1902	3000	400	85.3	25.80	23.30	3.18	32.30	7.07	16.3	6.81	9.8	1.40	-22.6
	12/14/75	2300	2920	340	87.1	29.80	21.70	5.08	32.20	8.20	15.3	5.39	15.8	1.46	-10.8
	12/15/75	0300	2840	300	88.3	29.10	20.70	3.43	29.30	9.35	13.9	5.33	11.7	1.58	-11.5
	12/15/75	0700	3480	440	86.0	31.50	19.80	3.05	27.80	9.26	13.9	5.18	11.0	1.61	0.7
	12/15/75	1100	3320	390	87.3	34.40	22.10	3.68	31.50	9.44			12.3	1.55	0.9
	12/15/75	1500	3520	360	88.7	30.90	19.80	4.25	29.00	9.08	16.5	5.97	14.7	1.57	-3.2
	12/15/75	1501	3560	360	88.8	32.30	20.00	4.00	29.00	9.08			13.8	1.57	1.3
	12/15/75	1900	3400	320	89.6	31.60	18.90	5.08	28.70	10.26	16.7	5.66	17.7	1.65	-5.0
	12/15/75	2300	3240	280	90.5	32.20	20.10	7.48	32.60	10.29	16.1	4.63	22.9	1.57	-11.6
	12/15/75	2301	3340	320	89.4	32.10	20.20	4.55	29.80	10.29	16.1	5.29	15.3	1.63	-5.9
	12/16/75	0300	3720	420	87.5	31.90	21.90	2.83	30.20	8.86	15.1	5.37	9.4	1.53	-1.7
	12/16/75	0700	3520	320	90.0	32.30	23.10	1.43	30.30	10.34	15.5	5.34	4.7	1.62	-6.5
	12/16/75	0701	3540	330	89.7	32.60	23.40	1.75	31.00	9.98	15.5	5.25	5.7	1.59	-5.6

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
710-1A	12/16/75	1100	3480	380	87.9	32.10	22.00	2.30	29.80	10.05	16.0	5.59	7.7	1.61	-4.9
	12/16/75	1500	3480	400	87.3	31.80	23.20	1.70	30.70	7.63	15.4	5.78	5.6	1.45	1.8
	12/16/75	1501	3420	390	87.4	32.00	23.30	4.18	33.30	7.63			12.6	1.42	-3.3
	12/16/75	1900	3320	340	88.7	31.60	19.40	4.35	28.60	7.88	15.3	5.60	15.2	1.50	5.4
	12/16/75	2300	3480	420	86.7	31.70	20.60	4.00	30.00	8.25	15.8	5.63	13.3	1.50	0.5
	12/16/75	2301	3500	410	87.0	32.00	20.80	7.10	33.10	8.25	15.8	4.87	21.5	1.45	-5.3
	12/17/75	0300	3720	440	86.9	31.20	18.40	4.50	27.50	10.20	16.4	5.81	16.4	1.67	-3.4
	12/17/75	0700	3720	400	88.1	31.20	18.40	4.50	27.50	10.13	16.1	5.73	16.4	1.67	-3.1
	12/17/75	1100	3480	400	87.3	31.30	22.20	2.05	29.80	10.17	16.1	5.76	6.9	1.62	-8.1
	12/17/75	1500	3840	460	86.8	30.70	22.10	1.78	29.40	8.14	15.6	6.08	6.1	1.50	-0.9
	12/17/75	1501	3920	480	86.5	31.30	22.00	3.70	31.20	8.14			11.9	1.47	-3.0
	12/17/75	1900	3560	320	90.1	30.80	21.90	0.43	27.80	8.25	15.6	6.36	1.5	1.54	2.6
	12/17/75	2300	2880	200	92.3	30.80	20.50	4.28	29.90	8.75	14.9		14.3	1.53	-4.2
	12/17/75	2301	2840	190	92.6	24.00	21.30	5.98	32.60	1.36	14.9		18.3	1.08	-2.4
	12/18/75	0300	2680	180	92.6	30.80	21.70	1.78	28.90	9.27	14.5		6.2	1.58	-4.1
	12/18/75	0700	2440	140	93.7	31.10	19.30	3.48	27.60	10.70	15.8		12.6	1.71	-6.0
	12/18/75	1100	2480	160	92.9	30.90	18.40	3.90	26.90	10.80	15.5		14.5	1.73	-5.5
	12/18/75	1500	2280	200	90.3	33.20	21.10	1.83	28.20	8.04	14.6		6.5	1.52	9.6
	12/18/75	1900	2800	300	88.2	32.70	19.00	3.05	26.80	8.71	14.6		11.4	1.59	8.6
	12/18/75	2300	2640	240	90.0	29.80	18.20	3.05	25.80	8.36	14.9		11.8	1.59	3.6
	12/19/75	0300	2880	320	87.7	30.00	18.00	3.00	25.50	8.36	14.6		11.8	1.60	5.0
	12/19/75	0301	2960	360	86.6	22.90	18.70	4.53	27.90	1.95	13.9		16.2	1.13	3.8
	12/19/75	0700	3080	360	87.1	29.90	19.50	3.13	27.50	7.69	14.6		11.4	1.51	2.8
	12/19/75	0701	3080	350	87.4	22.90	21.60	1.70	28.70	1.02	15.7		5.9	1.06	6.5
	12/19/75	1100	3400	410	86.7	29.50	20.60	2.55	28.30	6.13	14.6		9.0	1.39	6.3
	12/19/75	1500	2960	300	88.8	29.90	19.40	4.35	28.60	9.40	14.7	5.43	15.2	1.60	-7.1
	12/19/75	1900	2880	160	93.9	30.00	19.70	3.38	28.00	7.48	15.0	5.98	12.1	1.49	2.9
	12/19/75	2300	3000	140	94.9	30.80	18.10	4.68	27.50	8.66	15.1	5.62	17.7	1.57	1.6
	12/20/75	0300	3040	130	95.3	30.30	17.30	6.08	27.70	8.61	14.9	5.45	21.9	1.57	-0.2
	12/20/75	0700	2880	170	93.5	30.10	19.90	3.73	28.60	8.91	14.3	5.38	13.0	1.57	-4.3
	12/20/75	0701	2900	175	93.4	29.90	19.90	6.73	31.60	8.91	14.3	4.80	21.3	1.51	-12.0
	12/20/75	1100	2800	120	95.3	30.10	20.20	3.95	29.20	8.42	7.9	2.97	13.5	1.52	-3.6
	12/20/75	1500	2960	100	96.3	30.50	21.80	3.45	30.70	8.14	14.8	5.47	11.3	1.49	-4.5
	12/20/75	1900	3280	300	89.9	29.80	20.10	3.78	28.90	9.24	14.2	5.30	13.1	1.58	-7.4
	12/20/75	2300	3280	300	89.9	30.00	22.00	2.20	29.70	6.91	14.5	5.83	7.4	1.42	1.3
	12/21/75	0300	3400	340	89.0	30.60	21.90	3.43	30.80	7.87	14.9	5.52	11.1	1.46	-3.3
	12/21/75	0700	3400	340	89.0	30.30	20.50	3.18	28.80	8.26	14.9	5.72	11.0	1.52	-1.3
	12/21/75	0701	3440	330	89.4	31.80	20.50	6.78	32.40	8.26	14.9	4.73	20.9	1.46	-4.5
	12/21/75	1100	3040	320	88.4	30.70	22.90	2.68	31.30	9.07	14.5	5.20	9.6	1.53	-9.1
	12/21/75	1500	3120	360	87.2	29.50	22.60	2.75	31.00	7.26	13.5	5.26	8.9	1.43	-5.0
	12/21/75	1700	3200	520	82.0	27.80	24.40	2.30	32.80	4.76			7.0	1.26	-4.5
	12/21/75	1900	3440	640	79.4	26.40	18.30	7.53	30.40	4.68	12.8	5.32	24.8	1.28	-3.2
	12/21/75	2100	3600	640	80.3	26.70	24.70	2.03	32.90	3.94			6.2	1.22	-5.1
	12/21/75	2300	3920	700	80.2	27.10	25.60	1.41	33.40	3.92	14.1	6.23	4.2	1.21	-4.8
	12/22/75	0100	3920	700	80.2	26.90	24.70	2.23	33.10	4.21			6.7	1.23	-6.1
	12/22/75	0300	4000	700	80.6	26.60	21.40	3.85	30.60	4.33	14.9	7.01	12.6	1.26	-1.3
	12/22/75	0500	3880	640	81.7	27.30	25.40	1.86	33.60	4.12			5.5	1.22	-5.4
	12/22/75	0700	3880	640	81.7	36.70	33.50	2.53	44.40	4.31	16.3	7.24	5.7	1.18	0.3
711-1A	12/24/75	1500	3000	560	79.3	26.90	22.90	2.88	31.50	4.84	15.7	6.84	9.1	1.28	-5.0
	12/24/75	1900	2800	440	82.6	27.00	23.00	2.85	31.60	5.01	15.3	6.66	9.0	1.29	-5.6
	12/24/75	2300	2680	400	83.5	26.80	22.00	3.10	30.60	5.86	14.9	6.43	10.1	1.35	-7.8

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO_2 INLET PPM	SO_2 OUTLET PPM	SO_2 REMOVAL %	CAO WT %	SO_2 WT %	SO_3 WT %	TOTAL S AS SO_3 WT. %	CO_2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
711-1A	12/25/75	0300	2640	400	83.2	27.60	23.70	2.68	32.30	4.79	15.3	6.49	8.3	1.27	-4.1
	12/25/75	0700	2640	340	85.8	28.80	22.70	4.53	32.90	5.78	16.2	6.22	13.8	1.32	-5.6
	12/25/75	1100	2680	340	86.0	27.90	24.00	1.90	31.90	6.69	14.8	6.10	6.0	1.38	-10.6
	12/25/75	1500	2720	340	86.2	29.60	24.00	4.10	34.10	5.83	17.9	6.64	12.0	1.31	-5.8
	12/25/75	1900	3160	440	84.6	29.30	19.00	7.25	31.00	7.98	14.6	5.13	23.4	1.47	-8.8
	12/25/75	2300	3800	640	81.4	28.30	21.60	6.40	33.40	5.39	16.1	6.09	19.2	1.29	-6.9
	12/26/75	0300	3680	560	83.2	28.50	25.30	1.98	33.60	4.29	16.2	6.77	5.9	1.23	-1.8
	12/26/75	0700	3440	440	85.9	29.40	21.60	6.30	33.30	6.82	14.4	5.08	18.9	1.37	-8.9
	12/26/75	1100	3560	440	86.3	29.60	26.00	1.01	33.50	6.91	14.7	5.71	3.0	1.39	-9.0
	12/26/75	1500	3680	430	85.6	29.40	25.30	1.68	33.30	5.95	14.3	5.68	5.0	1.33	-5.1
	12/26/75	1900	3520	420	86.8	28.80	22.70	1.43	29.80	6.26	14.9	6.31	4.8	1.38	-0.2
	12/26/75	2300	2960	380	85.8	28.80	22.30	2.63	30.50	6.88	14.5	5.88	8.6	1.41	-4.6
	12/27/75	0300	2800	420	83.4	28.30	20.70	3.43	29.30	6.01	13.6	5.75	11.7	1.37	0.4
	12/27/75	0700	2880	440	83.1	28.30	19.40	6.85	31.10	6.89	14.1	5.30	22.0	1.40	-8.0
	12/27/75	1100	2800	360	85.0	27.70	16.60	7.05	27.80	7.31	15.3	6.07	25.4	1.48	-3.9
	12/27/75	1500	2520	350	84.6	28.10	21.20	2.80	29.30	6.22	15.0	6.44	9.6	1.39	-1.2
	12/27/75	1900	2520	440	80.7	27.20	21.10	0.93	27.30	7.31	13.6	6.17	3.4	1.49	-4.6
	12/27/75	2300	2840	540	78.9	26.20	19.00	4.85	28.60	3.87	13.0	5.98	17.0	1.25	4.7
	12/28/75	0300	2680	440	81.8	26.60	18.70	6.53	29.90	4.22	13.9	5.96	21.8	1.26	1.0
	12/28/75	0700	2840	540	78.9	25.60	20.90	4.38	30.50	2.67	14.2	6.63	14.4	1.16	3.3
	12/28/75	1100	2840	620	75.8	24.60	21.00	2.05	28.30	2.36	14.6	7.50	7.3	1.15	7.2
	12/28/75	1500	3140	820	71.1	25.70	23.30	3.08	32.20	2.63	14.9	6.90	9.6	1.15	-0.8
	12/28/75	1900	3320	840	72.0	25.70	22.30	4.03	31.90	3.05	14.7	6.70	12.6	1.17	-2.1
	12/28/75	2300	3600	800	75.4	26.20	20.60	4.65	30.40	4.79	14.9	6.52	15.3	1.29	-4.6
	12/29/75	0300	3840	940	72.9	26.10	22.50	3.18	31.30	4.13	14.9	6.75	10.2	1.24	-4.2
	12/29/75	0700	3720	960	71.4	25.70	22.80	2.60	31.10	3.40	14.2	6.63	8.4	1.20	-1.6
	12/29/75	1100	3520	800	74.8	25.50	22.30	2.43	30.30	4.02	15.0	7.06	8.0	1.24	-3.3
	12/29/75	1500	3080	600	76.4	25.80	23.80	0.65	30.40	3.32	14.7	7.19	2.2	1.20	1.1
	12/29/75	1900	2960	560	79.1	25.40	16.40	5.00	25.50	6.15	14.9	6.95	19.6	1.44	-1.2
	12/29/75	2300	3000	660	75.6	25.30	20.00	2.80	27.80	5.06	15.3	7.30	10.1	1.33	-2.5
	12/30/75	0300	3400	780	74.6	26.30	21.80	2.05	29.30	4.46	15.3	7.17	7.0	1.28	0.4
	12/30/75	0700	3400	720	76.5	26.60	19.00	3.75	27.50	5.45	15.6	7.09	13.7	1.36	1.5
	12/30/75	0701	3400	720	76.5	26.00	18.80	3.60	27.10	5.50	15.6	7.23	13.3	1.37	0.0
	12/30/75	1100	3280	640	78.4	25.80	17.30	5.08	26.70	6.33	14.7	6.62	19.0	1.43	-3.8
	12/31/75	1237													
711-1B	12/30/75	1500	3120	780	72.3	25.30	23.90	1.53	31.40	2.75	15.1	7.29	4.9	1.16	-0.8
	12/30/75	1900	3040	520	81.1	23.30	17.30	3.98	25.60	4.17	15.1	7.72	15.5	1.30	0.2
	12/30/75	2300	3000	500	81.6	26.40	18.60	3.65	26.90	5.93	15.8	7.20	13.6	1.40	0.0
	12/31/75	0300	3100	500	82.1	26.70	18.70	3.63	27.00	5.46	15.0	6.90	13.4	1.37	3.1
	12/31/75	0700	3000	500	81.6	25.80	19.90	2.03	26.90	5.56	14.6	7.02	7.5	1.38	-0.5
	12/31/75	1100	3080	580	79.1	24.10	15.90	2.73	22.60	7.87	15.6	7.76	12.1	1.63	-7.3
	12/31/75	1500	2480	380	83.0	25.90	15.20	4.90	23.90	5.85	14.8	7.05	20.5	1.45	6.6
	12/31/75	1960	2520	380	83.3	25.90	15.20	4.90	23.90	5.85	14.0	6.66	20.5	1.45	6.6
	12/31/75	2300	2460	380	82.9	26.00	16.50	4.98	25.60	5.15	13.7	6.43	19.4	1.37	5.6
	01/01/76	0300	2920	460	82.6	26.30	18.30	3.43	26.30	6.10	14.6	6.73	13.0	1.42	0.4
	01/01/76	0700													
	01/01/76	1100	2960	520	80.6	27.00	18.00	4.10	26.60	7.43	15.6	6.79	15.4	1.51	-4.1
	01/01/76	1500													
	01/01/76	1900	2840	440	82.9	27.30	15.00	4.85	23.60	7.98	14.7	6.40	20.6	1.62	4.3
	01/01/76	2300	2880	440	83.1	28.00	20.10	3.48	28.60	7.05	15.4	6.46	12.2	1.45	-3.6
	01/02/76	0300	3640	840	74.4	27.50	21.90	2.83	30.20	5.83	15.3	6.61	9.4	1.35	-3.9

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
711-1B	01/02/76	0700													
	01/02/76	1100	3280	680	77.0	27.30	25.30	3.18	34.80	3.14	15.6	6.62	9.1	1.16	-3.9
712-1A	01/02/76	1500	2640	380	84.1	29.10	24.20	2.45	32.70	4.93	15.1	6.16	7.5	1.27	-0.3
	01/02/76	1900	2560	340	85.3	29.80	24.30	0.93	31.30	8.11	14.7	5.76	3.0	1.47	-8.3
	01/02/76	2300	2600	360	84.7	29.30	18.00	4.10	26.60	7.97	15.0	6.07	15.4	1.55	1.7
	01/03/76	0300	2800	420	83.4	29.80	19.50	4.03	28.40	8.68	15.2	5.78	14.2	1.57	-4.7
	01/03/76	0700													
	01/03/76	1100	3200	380	86.9	29.80	18.60	5.85	29.10	9.13	15.2	5.46	20.1	1.57	-7.4
	01/03/76	1500													
	01/03/76	1900	3200	400	86.2	28.60	21.80	0.95	28.20	7.42	15.1	6.52	3.4	1.48	-2.1
	01/03/76	2300	3200	340	88.3	30.10	19.70	3.68	28.30	10.23	15.5	5.69	13.0	1.66	-9.2
	01/04/76	0300	3120	280	90.1	30.00	19.20	4.70	28.70	9.85	16.3	5.85	16.4	1.62	-8.9
	01/04/76	0700													
	01/04/76	1100	3560	380	88.2	28.50	16.70	4.93	25.80	9.13	15.2	6.13	19.1	1.64	-4.2
	01/04/76	1500													
	01/04/76	1900	3760	500	85.3	28.00	23.50	0.43	29.80	5.04	13.1	5.95	1.4	1.31	2.5
	01/04/76	2300	3720	460	86.3	28.50	20.30	3.33	28.70	8.75	15.2	6.07	11.6	1.55	-9.7
	01/05/76	0300	3280	360	87.9	28.70	18.70	2.03	25.40	9.71	14.9	6.25	8.0	1.70	-5.1
	01/05/76	0700													
	01/05/76	1100	3520	500	84.3	29.30	19.00	5.25	29.00	8.30	14.6		18.1	1.52	-5.4
	01/05/76	1500													
	01/05/76	1900	3440	400	87.1	29.90	22.70	2.13	30.50	7.06	15.6		7.0	1.42	-1.5
	01/05/76	2300													
	01/06/76	0300	2920	240	90.9	31.30	19.80	5.25	30.00	11.07	13.9		17.5	1.67	-12.2
	01/06/76	0700	3200	280	90.3	32.10	19.60	3.80	28.30	11.54	15.2	5.04	13.4	1.74	-7.6
	01/06/76	0701	3200	275	90.5	32.30	19.70	3.68	28.30	11.38			13.0	1.73	-6.3
	01/06/76	1100	3200	310	89.3	32.90	20.80	3.90	29.90	10.88	15.8	5.05	13.1	1.66	-5.8
	01/06/76	1500													
	01/06/76	1900	3080	360	87.1	31.90	20.40	3.30	28.80	9.08	14.9	5.37	11.5	1.57	0.5
	01/06/76	2300													
	01/07/76	0300	3880	600	62.9	30.80	19.90	5.43	30.30	8.53	15.7	5.47	17.9	1.51	-4.2
	01/07/76	0700													
	01/07/76	1100	3440	400	87.1	30.10	24.00	1.60	31.60	6.34	15.5	6.17	5.1	1.36	-0.4
712-1B	01/07/76	2200	2680	100	95.9	36.00	13.30	3.98	20.60	19.25			19.3	2.70	-8.2
	01/07/76	2230				35.30	14.60	3.45	21.70	17.82			15.9	2.49	-7.4
	01/07/76	2300	2600	120	94.9	34.20	15.30	3.48	22.60	17.05	16.7	4.99	15.4	2.37	-9.6
	01/07/76	2330				32.90	15.60	3.40	22.90	15.62			14.9	2.24	-9.3
	01/08/76	0000	2720	100	96.0	31.90	17.20	3.00	24.50	14.19			12.3	2.05	-10.5
	01/08/76	0030				31.40	17.60	2.80	24.80	12.98			11.3	1.95	-8.0
	01/08/76	0100	2880	140	94.7	30.80	19.60	2.00	26.50	11.44			7.6	1.79	-7.6
	01/08/76	0130				29.40	19.90	2.23	27.10	9.90			9.2	1.66	-7.5
	01/08/76	0200	3000	160	94.1	29.30	20.10	3.06	28.20	8.58			10.9	1.55	-5.9
	01/08/76	0230				27.60	20.90	2.18	28.30	7.32			7.7	1.47	-5.6
	01/08/76	0300	3200	280	90.3	25.70	21.60	1.40	28.40	4.68	13.9	6.71	4.9	1.30	-0.6
	01/08/76	0330				24.70	21.30	2.48	29.10	4.12			8.5	1.26	-3.8
	01/08/76	0400	3360	360	88.2	23.70	21.40	1.65	28.40	3.32			5.8	1.21	-1.4
	01/08/76	0430				22.60	22.30	0.73	28.60	1.97			2.6	1.13	1.1
	01/08/76	0500	3400	500	83.7	22.80	21.40	1.05	27.80	1.51			3.8	1.10	6.2
	01/08/76	0530				21.80	21.10	0.03	26.40	1.23			0.1	1.08	8.0
713-1A	01/08/76	1100	3600	600	91.6	24.50	16.50	3.98	24.60	4.46	15.3	7.73	16.2	1.33	6.5
	01/08/76	1500	3080	740	73.4	23.50	19.50	1.63	26.00	3.07	14.0	7.50	6.3	1.21	5.9

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
713-1A	01/08/76	1900	2760	500	79.9	22.40	17.10	4.43	25.80	2.03	14.0	7.50	17.2	1.14	7.8
	01/08/76	2300	2680	660	72.7	22.30	18.50	4.28	27.40	1.39	13.1	7.01	15.6	1.09	6.0
	01/09/76	0300	2800	600	76.3	23.00	16.90	6.68	27.80	1.76	13.5	6.81	24.0	1.12	5.6
	01/09/76	0700	3040	520	81.1	22.50	18.00	4.00	26.50	1.93	14.1	7.59	15.1	1.13	6.6
	01/09/76	1100	2920	700	73.4	24.20	20.90	3.88	30.00	1.41	14.4	7.21	12.9	1.09	5.7
	01/09/76	1500	2880	760	70.6	24.00	20.00	6.10	31.10	1.51	14.2	6.79	19.6	1.09	1.2
	01/09/76	1900	3000	780	71.2	23.90	19.00	6.45	30.20	1.72	14.8	7.11	21.4	1.10	2.3
	01/09/76	2300	2960	760	71.6	25.10	23.50	4.13	33.50	1.43	15.1	7.02	12.3	1.08	-0.7
	01/10/76	0300	2960	840	68.6	24.90	21.30	6.58	33.20	1.82	15.6	6.95	19.8	1.10	-2.7
	01/10/76	0700	3080	800	71.2	24.40	22.20	3.35	31.10	1.25	14.7	7.31	10.8	1.07	4.2
	01/10/76	1100	3080	840	69.8	24.50	22.10	2.78	30.40	1.68	12.9	6.45	9.1	1.10	4.3
714-1A	01/19/76	1900	3090	600	78.4	26.70	21.00	4.45	30.70	5.23	16.6	7.12	14.5	1.31	-5.5
	01/19/76	2300	2800	120	95.3	29.10	22.80	2.00	30.50	6.52	14.7	6.02	6.6	1.39	-2.0
	01/20/76	0300	2880	100	96.2	29.00	19.70	3.98	28.60	7.55	14.9	5.95	13.9	1.48	-2.3
	01/20/76	0700	2840	100	96.1	29.60	22.80	3.80	32.30	6.71	14.3	5.43	11.8	1.38	-5.3
	01/20/76	0701	2820	100	96.1	29.60	22.70	3.93	32.30	6.77	14.3	5.40	12.2	1.38	-5.6
	01/20/76	1100	3440	260	91.7	29.00	23.50	3.73	33.10	6.38	16.6	6.32	11.3	1.35	-8.0
	01/20/76	1500	3800	240	93.0	28.90	24.00	5.30	35.30	4.46	15.1	5.68	15.0	1.23	-5.2
	01/20/76	1900	3900	210	93.9	30.30	23.90	7.73	37.60	5.34	15.9	5.07	20.6	1.26	-9.4
	01/20/76	2300	3880	160	95.5	28.80	22.20	7.35	35.10	5.08	16.2	5.78	21.0	1.26	-7.8
	01/21/76	0300	3560	80	97.6	29.90	22.80	6.20	34.70	5.49	16.3	5.72	17.9	1.29	-4.7
	01/21/76	0700	2900	70	97.3	28.50	22.10	5.98	33.60	4.70	16.0	6.16	17.8	1.25	-3.6
	01/21/76	1100	2360	150	93.0	28.70	21.10	5.63	32.00	5.53	13.5	5.23	17.6	1.31	-2.7
	01/21/76	1500	2280	200	90.3	28.60	19.00	6.45	30.20	6.00	15.0	5.86	21.4	1.36	-0.7
	01/21/76	1900	3200	360	87.6	28.10	20.00	4.90	29.90	6.00	15.9	6.49	16.4	1.37	-1.7
	01/21/76	2300	3280	400	86.5	28.10	22.50	2.98	31.10	5.33	15.9	5.70	9.6	1.31	-1.7
	01/22/76	0300	3040	210	92.4	27.90	20.00	4.50	29.50	6.26	15.9	6.59	15.3	1.39	-2.7
	01/22/76	0301	3040	215	92.2	26.80	19.20	6.10	30.10	4.60	15.9	6.75	20.3	1.28	-0.5
	01/22/76	0700	2980	150	94.3	28.30	22.90	3.48	32.10	5.56	16.2	6.60	10.8	1.32	-4.5
	01/22/76	1100	2680	170	93.0	28.10	23.20	3.60	32.60	5.83	15.6	6.24	11.1	1.33	-7.7
	01/22/76	1500	2560	270	88.3	27.50	20.50	5.08	30.70	5.34	15.3	6.32	16.5	1.32	-2.9
	01/22/76	1900	2800	430	83.0	26.80	20.10	4.98	30.10	4.02	15.3	6.72	16.5	1.24	2.2
	01/22/76	2300	2840	320	87.5	27.70	20.20	4.95	30.20	4.79	14.4	6.09	16.4	1.29	1.6
	01/23/76	0300	3520	610	80.8	26.80	19.20	6.10	30.10	4.60	15.9	6.75	20.3	1.28	-0.5
	01/23/76	0700	3680	720	78.3	26.00	23.40	2.75	32.00	3.25	15.9	7.26	8.6	1.18	-2.1
	01/23/76	1100	3240	560	80.9	26.50	20.30	6.93	32.30	3.68	15.8	6.59	21.5	1.21	-3.1
	01/23/76	1500	2800	320	87.4	27.00	24.50	2.88	33.50	3.58	15.1	6.53	8.6	1.19	-3.8
	01/23/76	1900	2840	320	87.5	27.30	24.10	3.16	33.30	3.98	14.2	6.02	9.5	1.22	-4.0
	01/23/76	2300	2640	170	92.9	28.40	23.60	3.70	33.20	4.37	13.9	5.65	11.2	1.24	-1.5
	01/24/76	0300	2640	150	93.7	29.90	22.90	7.28	35.90	4.89	14.3	4.91	20.3	1.25	-4.9
	01/24/76	0700	2640	140	94.2	29.00	25.10	3.13	34.50	6.10	14.2	5.42	9.1	1.32	-10.1
	01/24/76	1100	2720	140	94.3	29.40	24.10	4.58	34.70	5.74	14.5	5.30	13.2	1.30	-7.6
	01/24/76	1500	2560	160	93.1	29.00	25.00	4.16	35.40	4.96	14.5	5.48	11.7	1.25	-7.3
	01/24/76	1900	2240	150	92.6	28.70	19.40	7.25	31.50	5.88	14.4	5.39	23.0	1.34	-3.0
	01/24/76	2300	2360	240	88.8	26.90	16.30	7.43	27.80	8.24	14.8	5.77	26.7	1.54	-11.4
	01/25/76	0300	2900	390	84.6	32.70	21.00	7.35	33.60	5.01	14.8	4.85	21.9	1.27	8.5
	01/25/76	0700	3000	400	85.3	27.30	19.60	6.90	31.40	3.23	15.2	6.35	22.0	1.19	4.4
	01/25/76	1100	3240	500	82.1	26.70	18.80	6.00	29.50	4.55	15.3	6.60	20.4	1.28	0.9
	01/25/76	1500	2880	340	86.9	26.20	22.50	2.78	30.90	3.50	14.5	6.68	9.0	1.21	0.4
	01/25/76	1900	2800	250	90.1	26.60	20.20	5.85	31.10	4.11	13.7	5.82	18.8	1.24	-1.6
	01/25/76	2300	2760	300	88.9	27.10	22.40	4.00	32.00	4.46	13.9	5.90	12.5	1.25	-3.7

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
714-1A	01/26/76	0300	2640	210	91.2	30.50	22.70	4.63	33.00	4.35	14.6	5.56	14.0	1.24	6.0
	01/26/76	0700	2600	160	93.2	28.60	23.70	4.38	34.00	4.13	14.2	5.63	12.9	1.22	-1.7
715-1A	01/26/76	1900	3690			28.20	21.30	4.88	31.50	5.92	14.9	5.94	15.5	1.34	-5.0
	01/26/76	2300	3640	2230	32.0	27.30	19.10	3.73	27.60	6.05	18.7	8.22	13.5	1.40	0.9
	01/27/76	0300	3480	2100	33.1	27.70	18.60	2.45	25.70	6.00	15.9	7.35	9.5	1.42	7.4
	01/27/76	0700	3680	2360	28.9	24.90	16.90	3.38	24.50	5.39	16.6	8.24	13.8	1.40	3.5
	01/27/76	0701	3680	2450	26.2	24.90	18.10	1.58	24.20	5.39	16.6	8.29	6.5	1.41	4.3
	01/27/76	1100	3720	2280	32.0	23.80	15.10	3.63	22.50	5.28	15.6	8.10	16.1	1.43	5.5
	01/27/76	1500	3200	2240	22.4	21.40	11.30	3.28	17.40	5.68	17.7	10.25	18.8	1.59	9.2
716-1A	01/27/76	1900	3240	2480	15.1	20.00	10.90	4.48	18.10	3.30	11.5	6.93	24.7	1.33	15.6
	01/27/76	2300	3520	2640	16.8	14.60	7.30	2.98	12.10	2.24	13.4	9.65	24.6	1.34	22.4
	01/28/76	0300	3800	3080	10.1	13.80	7.90	0.83	10.70	2.30	13.5	10.18	7.7	1.39	24.5
	01/28/76	0700	3600	3160	2.6	15.50	5.80	2.15	9.40	4.51	16.6	11.82	22.9	1.87	20.4
	01/28/76	0701	3660	3160	4.2	12.20	5.70	10.08	17.20	4.51	16.6	10.36	58.6	1.48	-45.9
717-1A	01/28/76	1100				24.00	3.30	4.08	8.20	8.64	16.4	9.50	49.7	2.92	30.2
	01/28/76	1101				20.60	3.30	9.78	13.90	9.64	16.4	8.54	70.3	2.13	-0.7
	01/28/76	1500	3200	850	70.6	28.70	2.60	14.05	17.30	13.63	16.2	5.52	81.2	2.43	-2.7
	01/28/76	1900				30.50	2.30	12.23	15.10	16.76	17.5	5.67	81.0	3.02	-4.7
	01/28/76	2300	3240	140	95.3	40.10	2.20	5.15	7.90	34.45	15.4	2.39	65.2	8.93	-23.3
	01/29/76	0300	2760	360	85.6	41.40	8.80	7.70	18.70	18.27	14.9	3.14	41.2	2.78	12.1
	01/29/76	0700	2840	330	87.2	29.70	15.70	4.48	24.10	9.46	15.5	6.24	18.6	1.71	2.6
	01/29/76	1100	2690	270	88.9	29.60	15.00	7.75	31.50	5.67	15.5	5.66	24.6	1.33	1.0
	01/29/76	1500	2720	300	87.8	28.20	22.30	1.73	29.60	5.32	16.0	7.10	5.8	1.33	2.4
	01/29/76	1900	3020	430	84.2	27.00	22.20	1.95	29.70	5.71	16.6	7.38	6.6	1.35	-4.0
	01/29/76	2300	3200	400	86.2	28.10	23.30	6.98	36.10	4.71	15.8	5.73	19.3	1.24	-11.3
	01/30/76	0300	3360	550	81.9	30.20	23.90	9.33	39.20	3.51	15.1	4.71	23.8	1.16	-5.7
	01/30/76	0700	3440	610	80.4	29.10	23.70	7.18	36.80	3.85	13.7	4.92	19.5	1.19	-5.4
	01/30/76	1100	3480	490	84.4	27.90	25.00	5.96	37.20	3.74	13.8	5.20	16.0	1.18	-10.5
	01/30/76	1540	3100	420	85.0	25.00	21.50	3.13	30.00	4.40	14.4	6.75	10.4	1.27	-6.5
	01/30/76	1900	2920	300	88.6	26.80	25.30	1.98	33.60	3.69	15.2	6.75	5.9	1.20	-5.4
	01/30/76	2330	2940	295	88.9	26.90	25.20	5.81	37.30	2.59	15.9	6.31	15.6	1.13	-9.4
	01/31/76	0300	3000	310	88.6	25.70	22.80	2.60	31.10	2.98	14.6	6.89	8.4	1.17	0.5
	01/31/76	0700	3040	310	88.7	27.50	22.50	4.88	33.00	3.74	14.8	6.19	14.8	1.21	-1.4
	01/31/76	1100	2880	160	93.9	28.30	22.40	6.00	34.00	3.96	15.2	5.95	17.7	1.21	-2.0
	01/31/76	1530	3180	480	83.3	26.20	24.60	1.25	32.00	3.03	14.6	6.87	3.9	1.17	-0.3
	01/31/76	1900	3640	570	82.7	26.80	23.60	3.50	33.00	2.37	15.9	7.10	10.6	1.13	2.5
	01/31/76	2300	3400	610	80.1	26.40	22.10	6.38	34.00	2.26	15.8	6.71	18.8	1.12	-1.1
	02/01/76	0300	3200	350	87.9	26.50	21.60	4.50	31.50	3.96	16.7	7.28	14.3	1.23	-2.3
	02/01/76	0700	3000	370	86.4	26.70	21.50	5.43	32.30	3.58	15.5	6.57	16.8	1.20	-1.8
	02/01/76	1100	2960	200	92.6	27.50	21.60	6.00	33.00	3.74	14.7	6.00	18.2	1.21	-1.4
	02/01/76	1530	2660	325	86.5	23.90	23.00	0.95	29.70	2.53	14.4	7.43	3.2	1.15	-0.5
	02/01/76	1900	3040	310	88.7	24.40	21.10	2.23	28.60	3.14	15.2	7.65	7.8	1.20	1.5
	02/02/76	0700	3600	370	88.6	28.00	20.20	6.95	32.20	4.29	15.6	6.17	21.6	1.24	-0.1
	02/02/76	1100	3280	310	89.6	29.10	22.60	6.05	34.30	4.35	14.7	5.54	17.7	1.23	-1.6
	02/02/76	1545	2990	258	90.5	28.50	20.80	7.90	33.90	4.40	14.6	5.45	23.3	1.24	-3.0
	02/02/76	1900	3000	200	92.7	28.20	20.30	8.13	33.50	4.57	14.5	5.42	24.3	1.25	-3.9
	02/02/76	2330	2680	125	95.2	29.40	23.80	8.05	37.80	3.13	15.3	5.33	21.3	1.15	-3.6
	02/03/76	0300	2880	140	94.7	29.10	24.20	4.95	35.20	3.74	15.3	5.94	14.1	1.19	-1.1
	02/03/76	0730	2760	100	96.0	28.60	24.90	3.18	34.30	3.70	14.9	6.10	9.3	1.20	-0.5
	02/03/76	1130	2720	140	94.3	27.40	22.50	0.18	28.30	4.44	14.5	7.00	0.6	1.29	7.0
	02/03/76	1530	3060	295	89.3	28.00	23.30	5.08	34.20	3.36	14.9	6.01	14.9	1.18	-0.8

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
717-1A	02/03/76	1930	3380	325	89.4	32.40	23.80	11.95	41.70	3.41	15.7	4.03	28.7	1.15	-3.6
	02/03/76	2330	3260	270	90.9	30.00	23.40	7.65	36.90	3.74	16.9	5.76	20.7	1.18	-2.0
	02/04/76	0330	3100	400	85.7	29.10	22.20	7.15	34.90	4.02	14.6	5.36	20.5	1.21	-1.6
	02/04/76	0730	3220	550	81.1	25.50	19.90	4.93	29.80	2.85	14.9	6.92	16.5	1.17	3.9
	02/04/76	1130	3440	540	82.6	26.30	21.90	2.93	30.30	3.29	15.6	7.27	9.7	1.20	3.4
	02/04/76	1530	3280	375	87.4	27.50	23.10	4.43	33.30	4.13	16.0	6.64	13.3	1.23	-4.0
	02/04/76	1930	3120	455	83.9	22.80	20.40	0.50	26.00	2.92	16.1	8.92	1.9	1.20	3.8
	02/04/76	2330	2900	285	89.1	27.80	23.40	6.85	36.10	3.25	15.6	5.99	19.0	1.16	-5.9
	02/05/76	0330	3090	425	84.7	28.00	22.80	6.90	35.40	3.25	15.0	5.73	19.5	1.17	-3.4
	02/05/76	0730	3400	680	77.9	26.80	23.70	3.68	33.30	1.98	15.5	6.95	11.1	1.11	3.5

SUMMARY OF TCA RUNS FROM JUNE 1975 TO MID-FEBRUARY 1976

RUN NUMBER	START DATE	END DATE	HRS ON STRM	LIME OR LS	ALK ADDN PT.	MGO	FLY ASH	GAS RATE ACFM	TCA LIQ RATE GPM	TCA L/G GAL/ MACF	NO OF BEDS	TOT BED HGT IN.	TCA SPHERE TYPE	NO.OF HOLD TANKS	EFFLU RES TIME MIN	SOLID RECIRC WT %	SOLIDS DISCH RANGE %	M.E. SYSTEM CONFIG	M.E. WASH B/T	DE-WATER SYSTEM	M.E. SYSTEM D.P.RANGE IN. WATER	TCA D.P. IN. H2O
546-2A	06/06/75	06/17/75	207	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	1	15.0	15.0	35-44	2-3P/CV	I/I	CL	0.65-0.80	8.6
547-2A	06/18/75	06/23/75	112	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	1	15.0	15.0	35-43	2-3P/CV	I/I	CL	0.65-1.10	7.4
548-2A	06/23/75	06/27/75	71	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	1	15.0	15.0	22	2-3P/CV	C/I	CL	0.58-0.65	7.0
549-2A	06/27/75	07/02/75	112	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	1	15.0	15.0	30	2-3P/CV	C/I	CL	0.58-0.65	6.4
550-2A	07/02/75	07/08/75	119	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	1	15.0	15.0	37-41	2-3P/CV	C/I	CL	0.66-0.83	6.4
551-2A	07/08/75	07/10/75	39	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	1	15.0	15.0	39-41	2-3P/CV	C/I	CL	0.66-0.80	6.6
552-2A	07/10/75	07/14/75	86	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	38-41	2-3P/CV	C/I	CL	0.68-0.75	7.7
553-2A	07/19/75	07/21/75	42	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	32-37	1-3P/OV	I/I	CL	0.31-0.36	8.6
554-2A	07/25/75	07/28/75	60	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	36-40	1-3P/OV	I/I	CL	0.18-0.40	5.2
555-2A	07/29/75	08/01/75	63	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	25	1-3P/OV	C/I	CL	0.18-0.23	5.2
556-2A	08/01/75	08/05/75	89	LS	EHT	N	Y	22500	1200	66	3	15.0	TPR	1	15.0	15.0	31-45	1-3P/OV	C/I	CL	0.16-0.23	5.8
557-2A	08/05/75	08/13/75	181	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	39-44	1-3P/OV	C/I	CL	0.36-0.44	7.4
558-2A	08/15/75	09/02/75	398	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	34-42	1-3P/OV	C/I	CL	0.37-0.43	7.5
559-2A	09/05/75	09/22/75	384	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	36-42	1-3P/OV	C/I	CL	0.38-0.43	7.6
560-2A	09/23/75	09/29/75	142	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	36-41	1-3P/OV	C/I	CL	0.38-0.42	7.6
561-2A	09/30/75	10/06/75	135	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	15.0	15.0	37-44	1-3P/OV	C/I	CL	0.35-0.40	7.4
562-2A	10/06/75	10/30/75	134	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	12.0	15.0	37-43	1-3P/OV	C/I	CL	0.35-0.43	7.6
562-2B	10/30/75	11/06/75	134	LS	EHT	N	Y	30000	1200	50					12.0	15.0	34-46				0.35-0.43	8.3
563-2A	11/06/75	11/14/75	182	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	12.0	15.0	36-46	1-3P/OV	C/I	CL	0.40-0.43	8.0
564-2A	11/14/75	11/19/75	113	LS	EHT	N	Y	30000	1200	50	3	15.0	TPR	1	12.0	15.0	38-45	1-3P/OV	C/I	CL	0.38-0.45	7.9
565-2A	11/21/75	11/26/75	109	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	3	12.0	15.0	34-43	1-3P/OV	C/I	CL	0.30-0.35	7.7
566-2A	11/26/75	12/03/75	166	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	3	12.0	15.0	34-44	1-3P/OV	C/I	CL	0.30-0.40	9.4
567-2A	12/03/75	12/09/75	138	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	3	12.0	15.0	37-43	1-3P/OV	C/I	CL	0.35-0.38	9.2
568-2A	12/09/75	12/16/75	162	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	3	12.0	15.0	38-46	1-3P/OV	I/I	CL	0.33-0.40	9.3
569-2A	12/16/75	12/19/75	66	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	3	9.0	15.0	33-44	1-3P/OV	I/I	CL	0.25-0.35	8.4
569-2B	12/19/75	12/23/75	97	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	9.0	15.0	37-44	1-3P/OV	I/I	CL	0.30-0.35	7.9
570-2A	12/23/75	12/29/75	144	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	9.0	15.0	34-41	1-3P/OV	I/I	CL	0.30-0.35	7.5
571-2A	12/29/75	01/02/76	96	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	9.0	15.0	34-42	1-3P/OV	I/I	CL	0.37-0.39	7.0
571-2B	01/02/76	01/02/76	11	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	9.0	15.0	N/A	1-3P/OV	I/I	CL	N/A	0.0
572-2A	01/02/76	01/09/76	154	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	9.0	15.0	34-47	1-3P/OV	I/I	CL	0.30-0.40	6.7
573-2A	01/09/76	01/11/76	45	LS	EHT	N	Y	30000	1000	42	3	15.0	TPR	3	12.0	15.0	N/A	1-3P/OV	I/	CL	N/A	0.0
573-2B	01/12/76	01/13/76	45	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	12.0	15.0	34-43	1-3P/OV	I/I	CL	0.30-0.35	6.9
574-2A	01/13/76	01/14/76	12	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	9.0	15.0	N/A	1-3P/OV	I/	CL	N/A	0.0
575-2A	01/15/76	01/17/76	47	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	12.0	15.0	35-39	1-3P/OV	I/	CL	0.30-0.38	6.6
576-2A	01/17/76	01/22/76	112	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	12.0	15.0	37-42	1-3P/OV	I/	CL	0.35-0.40	7.5
576-2B	01/22/76	01/22/76	3	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	12.0	15.0	N/A	1-3P/OV	I/	CL	N/A	0.0
577-2A	01/22/76	01/29/76	159	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	12.0	15.0	39-43	1-3P/OV	I/I	CL	0.35-0.41	8.8
578-2A	01/29/76	01/29/76	9	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	12.0	15.0	N/A	1-3P/OV	I/I	CL	N/A	0.0
579-2A	01/29/76	02/01/76	62	LS	EHT	N	Y	30000	1000	42	3	15.0	FOAM	3	9.0	15.0	40-45	1-3P/OV	I/I	CL	0.45-0.55	9.7
580-2A	02/01/76	02/01/76	12	LS	EHT	N	Y	30000	1200	50	3	15.0	FOAM	3	9.0	15.0	N/A	1-3P/OV	I/I	CL	N/A	0.0
581-2A	02/04/76	02/11/76	164	LS	EHT	N	Y	30000	1200	50	3	15.0	FOAM	1	12.0	15.0		1-3P/OV	I/I	CL		
582-2A	02/11/76	02/12/76	10	LS	-	N	Y	30000	1200	50	3	15.0	FOAM	1	12.0	15.0		1-3P/OV	I/I	CL		

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
546-2A	06/06/75	2300	5.95											15.7
	06/07/75	0700	6.05											15.3
	06/07/75	1500	5.95											10.5
	06/07/75	2300	5.90											11.1
	06/08/75	0700	5.70											19.0
	06/08/75	1500	5.80	1490	150	30	52	120	1448	2091	5381	104	-3.1	14.0
	06/08/75	2300	5.70	1132	132	25	46	16	1507	1595	4453	102	-10.3	14.2
	06/09/75	0700	5.65											13.7
	06/09/75	1500	5.75	1162	168	31	64	112	896	1985	4418	62	-3.5	14.6
	06/09/75	2300	5.85	1155	179	31	15	32	1283	1843	4538	85	-7.3	14.1
	06/10/75	0700	5.85											13.2
	06/10/75	1500	6.10	1205	189	34	68	72	1301	1914	4783	86	-5.0	12.1
	06/10/75	2300	5.95	2070	207	38	64	144	2247	2836	7606	162	-5.5	9.3
	06/11/75	0700	6.15											9.3
	06/11/75	1500	5.70	2250	216	55	63	120	1621	3332	7657	122	2.5	9.7
	06/11/75	2300	6.00	2095	88	56	66	112	1447	3049	6913	117	-2.6	12.5
	06/12/75	0700	5.65	1745	248	46	65	48	1591	2623	6366	110	2.5	13.9
	06/12/75	1500	5.60	1510	229	42	59	120	1611	2375	5946	108	-6.2	
	06/12/75	2300	5.65	1460	234	41	62	208	1474	2233	5712	99	-3.6	16.7
	06/13/75	0700	5.65											16.1
	06/13/75	1500	5.90	1475	245	35	44	16	1425	2127	5367	95	6.6	17.2
	06/13/75	2300	5.95	1015	229	40	60	160	1267	1879	4650	76	-14.6	18.3
	06/14/75	0700	6.05											18.3
	06/14/75	1500	5.85	1015	247	33	53	16	1097	1772	4233	66	0.7	15.9
	06/14/75	2300	5.85	1225	219	42	64	28	1088	1808	4474	72	10.0	18.6
	06/15/75	0700	5.95											18.3
	06/15/75	1500	5.90	1655	245	39	68	20	1708	2375	6110	116	2.9	14.8
	06/15/75	2300	5.85	1880	256	46	65	152	1481	2623	6503	105	8.4	14.4
	06/16/75	0700	5.95											16.0
	06/16/75	1500	5.95	1005	248	41	57	60	368	2233	4012	24	2.2	15.9
	06/16/75	2300	5.85	1060	302	46	64	144	346	2056	4018	21	15.5	16.3
	06/17/75	0700	5.95	1090	292	73	58	80	649	2056	4288	40	10.6	17.8
547-2A	06/18/75	1500	5.92	1095	252	38	53	72	1030	2020	4560	64	-2.3	13.5
	06/18/75	2300	5.90	1475	232	38	50	56	1138	2446	5435	78	1.6	12.8
	06/19/75	0700	5.95											19.3
	06/19/75	1500	6.00	915	273	43	66	36	418	2233	3984	25	-1.3	17.2
	06/19/75	2300	5.90	1005	267	37	51	88	577	2162	4187	35	-0.2	16.3
	06/20/75	0700	5.80											17.9
	06/20/75	1500	6.00	962	304	45	64	112	477	2233	4197	28	1.2	15.9
	06/20/75	2300	6.00											17.0
	06/21/75	0700	5.95											15.0
	06/21/75	1500	6.00	1157	328	42	64	304	450	2020	4365	28	16.1	15.6
	06/21/75	2300	6.00	800	269	41	59	120	377	1843	3509	22	3.8	17.2
	06/22/75	1500	6.05											16.4
	06/22/75	2300	5.85	782	283	48	62	144	776	1595	3690	42	1.9	15.4
	06/23/75	0700	5.95	672	572	34	51	24	837	1489	3679	30	28.0	17.1
548-2A	06/23/75	2300	6.05											14.0
	06/24/75	1500	6.00	1000	141	32	52	88	301	1666	3280	22	13.6	14.8
	06/25/75	1500	6.10	507	142	22	20	152	225	850	1918	14	15.6	15.5
	06/25/75	2300	6.00	628	123	16	15	104	364	1028	2278	24	7.9	12.3

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
548-2A	06/26/75	1500	6.00	1495	112	51	15	104	1008	1701	4486	78	17.2	11.3
	06/26/75	2300	5.90	1175	100	32	16	48	727	1630	3728	55	9.2	13.8
	06/27/75	0700	5.98											12.7
549-2A	06/27/75	1500	5.90	1200	101	29	29	56	974	1701	4090	73	0.8	
	06/27/75	2300	5.90	1430	113	34	22	88	863	2091	4641	66	4.3	10.5
	06/28/75	0700	5.90											11.0
	06/28/75	1500	5.85	1830	122	39	22	24	900	2907	5844	72	2.2	11.2
	06/28/75	2300	5.85	1975	142	40	24	80	792	2942	5995	64	9.9	12.5
	06/29/75	0700	5.80											12.8
	06/29/75	1500	5.80	1950	161	46	28	144	694	3084	6107	55	7.3	13.4
	06/30/75	0700	5.90											12.7
	06/30/75	1600	5.85	1450	167	44	32	104	620	2481	4898	46	3.8	14.6
	06/30/75	2300	5.90											15.1
	07/01/75	1500	6.00	1285	166	45	33	96	957	2091	4673	68	-0.9	11.6
	07/01/75	2300	5.90	1540	164	40	36	48	1120	2446	5394	82	-0.6	12.4
550-2A	07/02/75	2300	5.80	2420	143	42	56	112	1372	2978	7123	111	15.0	11.1
	07/03/75	1500	5.89											10.2
	07/03/75	2300	5.90	2845	178	53	49	120	1644	3722	8611	133	11.2	10.2
	07/04/75	1500	5.95	2235	217	58	53	72	1260	3049	6944	96	14.4	12.7
	07/04/75	2300	5.90											15.2
	07/05/75	0700	5.80											12.2
	07/05/75	1500	5.55	1820	211	51	43	48	911	3297	6381	68	-1.5	11.0
	07/05/75	2300	5.80	1815	216	53	51	176	813	3332	6456	61	-3.0	13.3
	07/06/75	1500	5.75											14.2
	07/06/75	2300	5.85	1245	221	45	50	40	554	2659	4814	38	-4.8	14.7
	07/07/75	1600	5.90	1330	245	42	41	72	454	2517	4701	31	8.0	14.1
	07/07/75	2300	5.85											13.8
551-2A	07/08/75	1500	6.00	1160	251	39	42	176	441	2340	4449	29	2.1	
	07/08/75	2300	5.95	1040	232	43	44	40	462	2269	4130	30	-0.9	14.9
	07/09/75	1500	5.85	1010	251	39	43	72	291	2162	3868	19	6.8	14.8
	07/09/75	2300	5.70	1035	239	40	44	288	10	2340	3995	1	0.9	15.0
552-2A	07/10/75	2300	6.05	1410	214	41	43	136	398	2340	4532	29	14.5	13.6
	07/11/75	1500	6.05	895	249	36	43	112	417	2091	3843	25	-3.9	12.6
	07/11/75	2300	5.85											11.7
	07/12/75	0700	5.90											11.8
	07/12/75	1500	5.95	965	268	40	48	92	443	2269	4125	27	-3.2	14.4
	07/12/75	2300	6.00	822	253	40	41	128	202	2127	3613	12	-4.3	15.1
	07/13/75	1500	5.95											14.2
	07/13/75	2300	5.95	765	269	43	48	184	84	1985	3378	5	1.7	14.9
553-2A	07/19/75	2300	5.90	1455	265	41	53	368	1402	2233	5817	92	-3.9	9.4
	07/20/75	1500	5.50											9.8
	07/20/75	2300	5.75	1503	272	46	70	176	1412	2340	5819	93	1.4	11.7
554-2A	07/25/75	2300	6.15											12.8
	07/26/75	0700	6.00	1070	267	83	94	64	1161	1915	4654	69	1.9	13.2
	07/26/75	1500	5.95	1200	330	42	50	32	861	2199	4714	52	10.4	11.5
	07/26/75	2300	6.15	1315	302	45	42	672	1032	2556	5964	65	-18.0	11.9
	07/26/75	2301	6.15											11.6
	07/27/75	0700	6.15	1515	321	46	53	56	2280	2506	6779	138	-13.4	12.3
	07/27/75	1500	6.00											12.1
	07/27/75	2300	5.80	1060	274	83	484	72	1009	1986	4968	60	13.8	8.5

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SC3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
555-2A	07/29/75	2300	5.95	1380	191	33	33	88	1451	2056	5232	99	-4.1	9.5
	07/30/75	1500	6.10	1290	164	34	30	48	1038	1701	4305	73	11.6	11.1
	07/30/75	2300	5.85	1105	164	32	28	56	1111	1701	4197	75	-2.5	10.5
	07/31/75	2300	5.85	1535	162	35	29	56	1890	1524	5231	132	9.2	8.9
556-2A	07/31/75	1502	6.05											7.3
	08/01/75	1500	5.95	1190	139	32	31	112	1729	1170	4403	116	1.7	6.4
	08/01/75	2300	5.95											5.3
	08/02/75	0700	5.95	1555	186	34	27	112	1638	2162	5714	114	-3.0	5.1
	08/02/75	1500	5.95	2040	221	69	24	32	1676	2446	6508	123	15.3	6.5
	08/02/75	2300	5.85	1580	213	45	43	80	1646	2410	6017	113	-4.8	6.2
	08/03/75	0700	5.90	1570	241	35	25	120	1540	2375	5906	104	-1.7	7.7
	08/03/75	1500	6.20											5.2
	08/03/75	2300	6.15	1530	243	50	56	8	1969	2446	6302	129	-10.3	5.6
	08/04/75	1500	5.95	1390	243	46	55	72	1460	2234	5500	95	-2.6	9.2
	08/04/75	2300	6.00	1338	260	50	55	88	1488	2091	5370	95	-0.5	11.2
	08/05/75	0700	6.00	1170	247	68	46	88	785	1915	4319	51	12.4	11.0
557-2A	08/05/75	2300	6.10	1910	258	46	47	8	584	1914	3867	36	11.3	15.4
	08/06/75	1500	6.05	1290	231	46	55	96	1777	1808	5312	112	-3.6	7.4
	08/06/75	2300	5.85	1375	255	41	55	104	1872	1737	5439	118	2.4	7.1
	08/07/75	1500	5.80											6.4
	08/07/75	2300	6.00	1438	260	41	55	24	1920	2127	5865	122	-4.4	6.2
	08/08/75	0700	5.85											6.4
	08/08/75	1600	5.95	1185	267	44	58	112	1628	1811	5105	98	-3.9	12.4
	08/08/75	2300	6.00											14.3
	08/09/75	0700		1050	283	60	23	128	1331	1737	4612	77	-1.3	
	08/09/75	1500		922	289	41	62	8	1152	1744	4218	64	-0.3	
	08/09/75	1900	5.95											13.0
	08/09/75	2300	6.00	745	260	41	55	144	700	1772	3717	38	-10.4	13.4
	08/10/75	0700	5.85	1055	313	60	28	64	1443	1772	4735	80	0.1	12.2
	08/10/75	1500	5.80											13.6
	08/10/75	2300	5.90	701	316	41	55	144	594	1595	3446	30	5.0	13.3
	08/11/75	1500	6.05	854	318	44	62	80	1390	1648	4396	70	-7.1	9.0
	08/11/75	2300	5.90											11.2
	08/12/75	1500	6.00	820	314	44	56	96	1176	1382	3888	60	6.0	9.5
	08/12/75	2300	5.95	725	294	46	59	104	1186	1240	3654	58	2.5	10.4
	08/13/75	0700	5.95	734	267	41	55	88	988	1312	3485	51	3.2	
558-2A	08/15/75	1500	5.85	880	233	40	50	72	1633	1134	4042	90	-2.5	7.2
	08/15/75	2300	5.75	1507	329	34	54	144	2603	1276	5947	153	10.8	6.9
	08/16/75	0700	5.70	1165	271	41	52	144	2143	1347	5163	122	-3.2	6.3
	08/16/75	1500	5.60	1010	211	38	51	216	1911	1099	4536	111	-7.7	9.5
	08/16/75	2300	5.60	1210	305	40	52	104	2170	1311	5192	122	4.3	6.4
	08/17/75	0700	5.85	1190	285	38	57	168	2094	1382	5214	120	-1.0	5.4
	08/17/75	2300	6.05	1390	337	44	55	144	2196	1560	5716	127	6.6	4.9
	08/18/75	0700	5.55											5.2
	08/18/75	1500	6.00	1075	244	43	42	272	1948	1524	5148	112	-17.8	5.6
	08/19/75	1500	5.95	985	284	41	40	120	1875	1489	4834	101	-11.6	11.8
	08/19/75	2300	6.10	1195	348	47	98	64	1810	1737	5299	100	4.9	11.1
	08/20/75	0700	5.65	1680	348	58	60	48	2513	2269	6976	153	-0.9	9.5
	08/20/75	1500	5.75	1365	314	42	42	168	1744	2375	6050	105	-11.0	11.4
	08/21/75	0700	5.75											12.3

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
558-2A	08/21/75	2300	5.95	1085	332	48	52	56	1188	1879	4640	67	6.8	9.8
	08/22/75	1500	5.80	1320	295	49	53	56	2047	1560	5380	121	6.0	9.7
	08/22/75	2300	5.95											11.4
	08/23/75	0700	5.90	765	351	45	59	56	998	1740	4014	48	-1.0	14.8
	08/23/75	1500		1015	374	43	50	64	977	1701	4224	52	17.3	
	08/23/75	1900	6.00											12.0
	08/23/75	2300	5.90	1120	349	49	59	64	1038	2269	4948	59	1.2	11.8
	08/24/75	0700	5.80	1255	358	52	59	48	1530	2233	5535	88	-0.2	10.8
	08/24/75	1500	6.00											13.1
	08/24/75	2300	5.95	704	333	47	51	112	641	1843	3731	31	-3.4	13.2
	08/25/75	0700	6.00											11.3
	08/25/75	1500	6.00	830	289	45	50	96	1073	1843	4226	57	-12.1	11.3
	08/26/75	1500	6.00	1045	374	42	64	152	1436	1560	4673	75	10.1	12.2
	08/26/75	2300	5.90	640	349	48	60	128	798	1560	3583	36	0.7	13.2
	08/27/75	0700	5.90	945	369	46	64	192	1428	1666	4710	72	-0.4	12.1
	08/27/75	1500	5.75	857	395	50	67	168	1221	1666	4424	58	3.2	12.6
	08/28/75	0700	5.75											11.9
	08/28/75	2300	5.95	1175	434	69	74	32	1683	1630	5097	87	17.6	11.4
	08/29/75	1500	5.95	756	357	51	63	80	1287	1701	4295	60	-8.2	12.4
	08/29/75	2300	5.70											12.8
	08/30/75	0700	5.85	660	354	50	69	208	998	1595	3934	44	-7.5	14.4
	08/30/75	1500	5.75	928	380	56	84	16	1593	1666	4723	78	2.0	12.0
	08/30/75	2300	5.70	1015	380	55	72	24	1681	1701	4928	85	3.0	11.8
	08/31/75	0700	5.75	1075	314	47	68	120	2057	1524	5205	110	-6.7	12.3
	08/31/75	1500	5.85											11.4
	09/02/75	0700	5.90											12.2
559-2A	09/05/75	1500	5.60	1100	296	38	51	24	2214	1311	5034	120	-1.8	11.2
	09/06/75	0700	5.65	1225	350	33	40	112	2417	1524	5701	130	-4.0	8.1
	09/06/75	1500	5.35	1175	352	45	64	32	2308	1701	5677	123	-6.2	13.9
	09/06/75	2300	5.45	1075	337	45	63	184	1825	1772	5301	98	-9.0	12.6
	09/07/75	0700	5.60	1250	367	46	64	336	2199	1772	6034	120	-8.3	12.7
	09/07/75	1500	5.50											10.7
	09/07/75	2300	5.75	985	297	44	60	136	1884	1595	5001	100	-13.7	10.7
	09/08/75	0700	5.60											11.5
	09/08/75	1500	5.60	840	340	43	60	40	1591	1311	4225	77	3.0	13.6
	09/09/75	2300	5.85	520	346	47	59	88	1000	1418	3478	39	-0.7	15.0
	09/10/75	0700	6.15	541	346	42	63	112	1080	1418	3602	43	-10.8	15.1
	09/10/75	1500	5.75	552	397	43	64	92	1047	1365	3560	40	1.8	14.9
	09/11/75	0700	6.25											14.6
	09/11/75	2300	5.95	508	386	43	62	136	573	1453	3161	22	7.0	14.9
	09/12/75	1500	6.20	507	355	42	61	208	825	1595	3673	35	-8.9	14.1
	09/12/75	2300	5.95											12.9
	09/13/75	0700	5.85	1570	339	52	47	96	2467	1985	6556	148	0.0	10.2
	09/13/75	1500	5.85	1110	294	44	62	136	1321	2091	5058	77	-8.2	13.6
	09/13/75	2300	5.95	717	374	48	62	40	812	1914	3967	37	-2.4	14.2
	09/14/75	0700	6.05	756	318	48	59	40	921	1772	3914	46	-4.0	14.1
	09/14/75	1500	5.95											13.1
	09/14/75	2300	5.95	675	625	45	64	80	918	1666	4073	32	23.2	14.8
	09/15/75	0700	6.10											14.5
	09/15/75	1500	6.05	512	289	44	63	96	755	1595	3453	36	-9.2	14.1

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
559-2A	09/16/75	0700	6.00											13.8
	09/16/75	1500		635	369	49	62	64	997	1808	3984	43	-11.5	
	09/16/75	2300	6.30	750	449	50	57	48	1186	1879	4419	50	-1.2	12.5
	09/17/75	0700	5.99	1080	402	52	64	204	1552	1879	5233	80	0.5	11.9
	09/17/75	1500	5.95	420	343	51	61	152	892	1914	4233	45	-4.7	12.2
	09/18/75	0700	5.70											13.0
	09/18/75	2300	5.85	1445	388	49	59	8	2714	1772	6435	150	0.9	6.9
	09/19/75	1500	5.90	1505	407	61	68	64	1644	2800	6549	97	-1.6	12.5
	09/19/75	2300	5.95											14.0
	09/20/75	0700	6.05	635	431	54	60	48	833	2095	4356	39	4.2	14.5
	09/20/75	1500	5.55	1135	449	24	64	40	1294	2091	5097	67	9.7	11.9
	09/20/75	2300	6.00	807	354	51	50	112	876	2020	4270	44	-7.0	14.2
	09/21/75	0700	5.40	770	400	54	59	8	942	1914	4147	43	1.8	15.1
	09/21/75	1500	5.50											13.8
	09/21/75	2300	5.85	870	403	54	65	88	1118	1879	4477	54	2.6	13.5
	09/22/75	0700	5.90											
560-2A	09/23/75	1500	5.40	920	329	56	65	56	1161	1950	4537	61	-4.5	12.8
	09/23/75	2300	5.20	1030	374	51	61	24	1323	1953	4816	70	3.2	12.3
	09/24/75	0700	5.80	925	335	55	127	136	1270	1843	4691	66	-3.1	13.1
	09/24/75	1500	5.40	962	356	43	68	48	1355	2020	4852	70	-6.8	13.1
	09/25/75	0700	5.80											14.3
	09/25/75	1500	5.45	795	424	49	66	64	752	1879	4029	35	10.4	15.8
	09/25/75	2300	5.40	662	392	47	60	56	609	1808	3634	27	5.5	14.5
	09/26/75	0700	5.70	675	324	45	58	48	944	1772	3866	44	-11.1	13.7
	09/26/75	1500		818	377	46	62	40	980	1844	4167	47	2.7	
	09/27/75	0700		834	306	55	62	32	663	2269	4221	36	-11.1	
	09/27/75	1500	6.20	826	345	46	54	48	479	2269	4067	25	-3.0	13.5
	09/27/75	2300	5.30	866	355	46	54	32	682	2190	4225	36	-1.3	13.1
	09/28/75	0700	5.70	887	381	50	53	64	720	1666	3821	37	19.7	
	09/28/75	1500	6.20											
	09/28/75	2300	5.85	960	357	47	57	24	913	2095	4453	49	2.6	
	09/29/75	0700	5.70											13.7
561-2A	09/30/75	2300	5.70	864	365	59	60	40	628	2198	4214	33	1.5	12.5
	10/01/75	0700	6.20	1007	384	53	54	8	1024	2410	4940	54	-4.6	
	10/01/75	1500	6.00	1455	352	47	57	48	1156	2481	5596	72	9.3	
	10/01/75	1501	6.00	1485	360	49	56	40	1085	2491	5566	68	12.5	
	10/02/75	2300	6.00											12.3
	10/02/75	2301	6.00											12.7
	10/03/75	1500	5.90	1360	363	48	51	32	1119	2623	5596	68	3.0	9.1
	10/03/75	1501	5.90	1315	352	48	53	24	1138	2623	5553	68	-0.3	9.0
	10/03/75	2300	6.00											8.6
	10/03/75	2301	6.00											8.5
	10/04/75	0700	5.70	2250	417	57	55	72	1676	3332	7859	113	13.2	11.8
	10/04/75	0701	5.70	2165	399	56	56	72	1676	3297	7721	113	10.4	11.8
	10/04/75	1500	5.75	1425	351	51	52	56	1039	2854	5828	65	0.0	13.0
	10/04/75	1501	5.75											13.2
	10/04/75	2300	6.05	1020	696	54	53	40	566	2552	4981	24	24.2	13.9
	10/05/75	0700	5.95	1010	385	49	51	48	648	2588	4779	35	-2.6	14.7
	10/05/75	1500	5.85											11.9
	10/05/75	1501	5.85											11.8

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
561-2A	10/05/75	2300	6.00	1040	344	57	55	216	662	2375	4749	38	-2.5	12.8
	10/05/75	2301	6.00	1019	336	59	54	288	595	2198	4540	34	0.5	12.8
	10/06/75	0700	5.95											14.2
562-2A	10/07/75	2300	5.80	1057	350	48	51	72	1081	1808	4467	60	11.4	13.2
	10/07/75	2301		1047	346	48	53	64	1100	1808	4466	61	10.3	14.0
	10/08/75	0700	5.95	970	370	74	55	96	670	2304	4539	36	2.6	14.2
	10/08/75	0701		974	378	74	57	72	699	2304	4558	38	3.6	14.4
	10/08/75	1500	5.90	1015	383	50	51	88	908	2166	4661	49	4.0	12.4
	10/08/75	1501	5.90	1030	374	50	53	104	919	2198	4728	50	2.3	12.2
	10/08/75	2300	6.00	1640	399	57	59	72	1286	2410	5923	80	18.6	10.9
	10/08/75	2301	6.00	1650	464	57	59	104	1288	2446	6068	77	21.0	10.1
	10/09/75	0700	6.00	1675	370	52	52	48	1615	2659	6471	102	6.6	11.8
	10/09/75	1100	6.00											11.4
	10/09/75	1500	5.90	1457	373	59	53	48	1263	2765	6018	77	1.7	11.0
	10/09/75	1900	5.90											9.8
	10/09/75	2300	5.85	1857	390	55.	52	64	1582	3226	7226	102	2.3	10.7
	10/10/75	0300	5.85											9.6
	10/10/75	0700	5.80											10.8
	10/10/75	1100	6.05											12.7
	10/10/75	1500	6.10	1310	320	53	55	120	572	3155	5585	37	-8.9	12.3
	10/10/75	1900	5.80											13.5
	10/10/75	2300	5.75											12.8
	10/11/75	0300	5.90											14.0
	10/11/75	0700	5.90	1495	338	52	51			2765			5.8	11.8
	10/11/75	1100	5.90											14.0
	10/11/75	1500	6.00	1085	330	52	52	64	741	2694	5018	43	-9.6	13.5
	10/11/75	1900	5.90											14.8
	10/11/75	2300	6.05	1200	401	50	62	48	392	2552	4705	23	15.8	14.9
	10/12/75	0300	6.00											14.0
	10/12/75	0700	5.85	1500	338	26	51	56	752	2233	4956	49	23.8	13.1
	10/12/75	1100	5.90											13.4
	10/12/75	1500	5.85											12.8
	10/12/75	1900	5.95											12.5
	10/12/75	2300	5.90	1100	470	52	68	64	619	2233	4606	33	20.6	12.8
	10/13/75	0300	5.85											14.4
	10/13/75	0700	5.90	1120	386	51	58	40	1239	2340	5234	67	-1.6	13.9
	10/13/75	1100	5.75											14.1
	10/13/75	1500	5.95	730	327	50	57	8	460	2162	3794	23	-5.7	14.3
	10/13/75	1900	5.80											13.8
	10/13/75	2300	6.00	679	357	47	59	64	516	2162	3884	24	-9.8	14.9
	10/14/75	0300												13.9
	10/14/75	0700	5.75	752	352	44	50	52	716	1772	3738	35	5.0	14.3
	10/14/75	1500	5.95	835	345	49	50	40	877	1879	4075	45	1.6	12.9
	10/14/75	1900	5.95											11.8
	10/14/75	2300	5.90	1225	374	27	12	80	948	2127	4793	55	12.5	12.1
	10/15/75	0300	5.95											13.0
	10/15/75	0700	5.90											13.8
	10/15/75	1100	5.80											14.6
	10/15/75	1500												14.5
	10/15/75	1900												13.5

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
562-2A	10/15/75	2300												12.9
	10/16/75	0300												13.3
	10/16/75	0700												12.2
	10/16/75	1100												12.4
	10/16/75	1500	5.75											12.6
	10/16/75	1900	5.85											13.0
	10/16/75	2300		1135	417	52	51	32	345	2659	4691	20	12.2	12.8
	10/17/75	0300												13.2
	10/17/75	0700	5.80											12.0
	10/17/75	1100	5.80											14.0
	10/17/75	1500	5.85	977	363	53	63	104	577	2340	4477	32	2.3	15.0
	10/17/75	1501	5.85	967	368	52	61	112	568	2340	4468	31	2.1	15.0
	10/19/75	0300	5.90											10.5
	10/19/75	0700	5.80											10.1
	10/19/75	1100	5.75											11.2
	10/19/75	1500	5.75	2700	451	52	60	72	2534	3368	9237	173	14.9	11.6
	10/19/75	1900	5.75											13.7
	10/19/75	2300	5.90											14.9
	10/20/75	0300	6.00											14.6
	10/20/75	0700												13.5
	10/20/75	1100												11.9
	10/20/75	1500		1535	390	56	61	160	752	3297	6251	48	0.0	11.9
	10/20/75	1900												11.5
	10/20/75	2300												13.0
	10/21/75	0300												13.0
	10/21/75	0700												14.1
	10/21/75	1100												12.6
	10/21/75	1500	5.90	1330	606	57	58	64	393	3088	5596	21	19.4	12.3
	10/21/75	1900	5.90											12.3
	10/21/75	2300	5.85											11.4
	10/22/75	0300	5.80											15.0
	10/22/75	0700	5.85											17.0
	10/22/75	1100	5.80											16.4
	10/22/75	1500	5.80											16.9
	10/22/75	1900	5.95											15.8
	10/22/75	2300	5.85											16.1
	10/23/75	0300	5.80											16.1
	10/23/75	1500	6.00	1095	404	54	67	72	443	2659	4794	25	6.4	12.9
	10/23/75	1900	6.00											11.2
	10/23/75	2300	5.75											11.2
	10/24/75	0300	5.75											11.4
	10/24/75	0700	5.75											12.1
	10/24/75	1100	5.95											11.5
	10/24/75	1500	5.80	2270	388	65	56	48	354	3900	7081	26	20.7	11.6
	10/24/75	1900	5.85											12.6
	10/24/75	2300	5.80											13.3
	10/25/75	0300												13.9
	10/25/75	0700	5.80	2120	325	60	54	112	307	3084	6062	23	29.6	14.3
	10/25/75	1100	6.06											12.8
	10/25/75	1500	5.84	1730	359	53	54	368	296	3120	5980	20	13.5	11.7

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
562-2A	10/25/75	1900	5.83											9.8
	10/25/75	2300	5.85											12.8
	10/26/75	0302	5.91											15.2
	10/26/75	0700	6.02	1400	319	52	54	48	565	3332	5770	37	-7.2	15.3
	10/26/75	1100	5.85											13.4
	10/26/75	1500	5.81	1635	325	64		96	1056	3545		70		14.0
	10/26/75	1900	5.85											15.9
	10/26/75	2300	5.89											16.1
	10/27/75	0300	5.92											16.3
	10/27/75	0700	5.91	1280	377	54	58	8	383	3155	5315	24	1.6	16.6
	10/27/75	1100	5.93											16.6
	10/27/75	1500	5.93	1510	317	47	50	120	240	2836	5120	16	16.0	14.5
	10/27/75	1900	5.91											13.9
	10/27/75	2300	5.97											14.2
	10/28/75	0300	5.85											14.6
	10/28/75	0301	5.72											14.6
	10/28/75	0700	5.82	1200	360	50	56	56	308	2978	5008	19	1.4	14.2
	10/28/75	1111	5.90											14.0
	10/28/75	1500	5.91	1265	348	52	58	56	365	2942	5086	23	3.7	13.5
	10/28/75	1900	6.00											13.8
	10/28/75	2300	5.80											12.9
	10/29/75	0700	5.91	1500	338	53	65	80	607	2946	5589	40	8.3	13.6
	10/29/75	1100	5.89											14.9
	10/29/75	1500	6.00											13.9
	10/29/75	1501	6.00											14.5
	10/29/75	1900	5.87											14.3
	10/29/75	2300	5.95											14.5
	10/29/75	2301	5.95											14.3
	10/30/75	0300	5.84											15.7
	10/30/75	0700	5.89	1150	360	52	65	104	240	2765	4736	15	5.9	15.2
562-2B	10/30/75	1500	5.76	1380	345	47	56	136	451	2730	5145	29	10.9	13.6
	10/30/75	1900	5.76											13.1
	10/30/75	2300	5.64											12.5
	10/31/75	0300	5.60											12.1
	10/31/75	0700	5.40	2040	584	57	64	80	1484	3300	7609	90	18.2	12.7
	10/31/75	1100	5.90											12.6
	10/31/75	1500	5.85	1680	402	57	69	80	1253	3190	6731	79	2.6	12.9
	10/31/75	1900	5.80											12.3
	10/31/75	2300	5.90											13.2
	11/01/75	0300	5.73											15.8
	11/01/75	0700	5.67	1350	378	50	63	86	750	2907	5586	46	2.4	15.5
	11/01/75	1100	5.76											13.6
	11/01/75	1500	5.75	1305	382	51	66	112	750	2765	5431	45	4.0	12.6
	11/01/75	1900	5.76											11.0
	11/03/75	0300	5.72											11.1
	11/03/75	0700	5.50	1910	413	48	60	16	1734	3190	7371	111	4.8	13.7
	11/03/75	1100	5.59											12.4
	11/03/75	1500	5.60	1770	394	60	70	168	1326	2978	6766	85	7.5	13.5
	11/03/75	1900	5.61											12.1
	11/03/75	2300	5.93											11.6

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
562-2B	11/04/75	0300	5.82											11.2
	11/04/75	0700	5.73	2569	519	63	58	128	1747	3226	8310	117	25.4	11.7
	11/04/75	1100	5.72											12.4
	11/04/75	1500	5.73	2280	432	68	70	136	1682	3442	8110	113	12.1	11.6
	11/04/75	1900	5.71											11.6
	11/04/75	2300	5.67											12.3
	11/05/75	0300	5.66											13.4
	11/05/75	0700	5.72	1735	614	67	64	144	873	2836	6333	50	28.2	14.2
	11/05/75	1100	5.77											13.5
	11/05/75	1500	5.82	1380	441	60	69	104	720	2736	5510	42	13.5	14.0
	11/05/75	1900	5.78											13.3
	11/05/75	2300	5.69											13.8
	11/06/75	0300	5.77											14.5
	11/05/75	0700	5.81	1330	445	59	58	168	681	2481	5222	39	17.4	14.4
563-2A	11/06/75	1530	5.75	1295	377	57	66	184	941	2481	5401	56	5.6	14.1
	11/06/75	1900	5.79											13.0
	11/06/75	2300	5.85											12.7
	11/07/75	0300	5.79											14.0
	11/07/75	0700	5.91	1215	595	55	56	184	623	2375	5103	31	25.4	14.1
	11/07/75	1100	6.06											14.4
	11/07/75	1500	6.05	857	399	53	65	152	380	2269	4175	19	4.9	14.0
	11/07/75	1900	6.03											13.6
	11/08/75	0300	5.78											14.0
	11/09/75	0700	5.99	1274	396	51	58	120	758	2304	4961	45	16.1	14.0
	11/08/75	1100	5.86											13.7
	11/08/75	1500	5.97	935	416	50	61	192	837	2127	4618	42	2.8	12.9
	11/08/75	1900	5.85											13.4
	11/08/75	2300	5.89											12.5
	11/09/75	0300	5.70											12.6
	11/09/75	0700	5.94	882	628	49	54	64	815	1843	4335	33	28.9	13.2
	11/09/75	1100	5.77											13.0
	11/09/75	1500	5.95	805	363	46	56	96	817	1772	3955	40	5.6	12.8
	11/09/75	1900	5.95											13.6
	11/09/75	2300	5.96											13.6
	11/10/75	0300	5.93											14.6
	11/10/75	0700	5.95	614	389	47	55	52	448	1843	3448	19	5.3	14.8
	11/10/75	1100	6.40											14.3
	11/10/75	1500	6.09	492	317	42	54	104	466	1666	3141	20	-10.1	14.0
	11/10/75	1900	6.02											15.8
	11/10/75	2300	5.76											16.0
	11/11/75	0300	5.93											16.9
	11/11/75	0700	5.92	379	319	35	49	80	384	1347	2592	14	-0.2	17.3
	11/11/75	1100	6.07											17.2
	11/11/75	1500	6.05	398	374	42	56	72	408	1489	2839	14	3.0	16.3
	11/11/75	1900	6.15											15.7
	11/11/75	2300	6.15											16.1
	11/12/75	0300	6.15											17.4
	11/12/75	0700	6.15	590	398	39	61	160	788	1737	3773	32	-6.0	16.0
	11/12/75	1100												15.1
	11/12/75	1500	5.85	623	386	46	57	128	486	1808	3534	21	3.0	14.6

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
563-2A	11/12/75	1900	5.90											14.5
	11/12/75	2300	6.00											14.4
	11/13/75	0300	6.10											13.7
	11/13/75	0700		1015	373	46	55	40	512	2907	4948	29	-10.5	13.1
	11/13/75	1100		842	365	46	54	88	356	2410	4161	19	-2.9	14.3
	11/13/75	1600	5.65											15.5
	11/13/75	1900	5.85											15.9
	11/13/75	2300	5.70											15.2
	11/14/75	0300	5.65											15.3
	11/14/75	0700	6.05	1005	351	45	52	144	321	2783	4701	19	-7.9	15.7
564-2A	11/14/75	1900	5.35											13.5
	11/14/75	2300	5.10											11.1
	11/15/75	0300	5.10											10.3
	11/15/75	0700	5.10	1285	376	44	58	104	2169	2304	6340	119	-14.5	10.2
	11/15/75	1100	5.11											10.2
	11/15/75	1500	5.25	1360	378	45	56	80	2663	2198	6780	145	-16.7	10.3
	11/15/75	1900	5.20											9.3
	11/15/75	2300	5.15											8.7
	11/16/75	0300	5.15											7.4
	11/16/75	0700	5.15	1340	344	45	74	1200	2127	1879	7009	122	-28.5	8.1
	11/16/75	1100	5.10											9.6
	11/16/75	1500	5.10	1000	235	49	60	808	2251	1666	6069	124	-56.4	9.1
	11/16/75	1900	5.25											9.7
	11/16/75	2300	5.25											10.0
	11/17/75	0300	5.25											9.7
	11/17/75	0700	5.40	1365	491	40	57	224	2327	2056	6560	120	-0.3	10.4
	11/17/75	1100	5.05											9.1
	11/17/75	1500	5.00	1470	397	43	58			2269			-104.5	8.1
	11/17/75	1900	5.00											7.5
	11/17/75	2300	5.25											8.6
	11/18/75	0300	5.25											9.4
	11/18/75	0700	5.25	1310	324	36	50	704	1759	2056	6239	104	-18.3	10.2
	11/18/75	1100	5.20											8.3
	11/18/75	1500	5.00	1530	325	49	70	1224	2367	1418	7033	144	-9.5	7.0
	11/18/75	1900	5.25											9.2
	11/18/75	2300	5.20											11.5
	11/19/75	0300	5.25											10.8
	11/19/75	0700	5.30	1017	372	69	58	104	2296	1772	5686	112	-16.9	12.6
565-2A	11/21/75	1900	5.05											15.1
	11/21/75	2300	5.50											17.0
	11/22/75	0300	5.35											14.9
	11/22/75	0700	5.25	1232	342	39	50	656	1602	1772	5693	92	-7.7	13.7
	11/22/75	1100	5.30											15.4
	11/22/75	1500	5.25	1085	320	37	50	568	1459	1808	5327	82	-14.7	13.3
	11/22/75	1900	5.25											13.1
	11/22/75	2300	5.35											13.2
	11/23/75	0300	5.25											12.7
	11/23/75	0700	5.15	1355	409	38	59	512	2669	1737	6776	142	-12.5	11.9
	11/23/75	1100	5.15											12.8
	11/23/75	1500	5.30	1260	346	35	50	608	2143	1666	6108	119	-13.5	13.9

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
565-2A	11/23/75	1900	5.35											13.3
	11/23/75	2300	5.10											14.3
	11/24/75	0300	5.10											14.2
	11/24/75	0700	5.20	1042	461	38	60	678	1758	1808	5845	84	-12.3	13.7
	11/24/75	1100	5.20											13.4
	11/24/75	1500	5.25	910	351	33	50	616	1252	1560	4772	64	-11.0	14.7
	11/24/75	1900	5.35											13.4
	11/24/75	2300	5.35											13.3
	11/25/75	0300	5.20											12.6
	11/25/75	0700	5.25	1307	446	36	57	432	2326	1595	6199	121	0.7	11.7
	11/25/75	1100	5.25											11.3
	11/25/75	1500	5.25	1535	248	38	59	232	2467	2410	6969	156	-24.9	10.7
	11/25/75	1900	5.25											11.5
	11/25/75	2300	5.10											11.3
	11/26/75	0300												10.7
566-2A	11/26/75	0700	5.15	1550	434	34	57	488	1397	2268	6828	115	-1.5	11.1
	11/26/75	1500	5.70	1450	327	40	52	120	2097	2127	6213	126	-4.2	14.2
	11/26/75	1900	5.75											16.2
	11/26/75	2300	5.85											16.9
	11/27/75	0300	5.95											17.0
	11/27/75	0700	6.00	1247	461	40	56	88	1143	2446	5481	62	8.1	16.0
	11/27/75	1100	5.95											15.6
	11/27/75	1500	5.80	1360	426	44	52	86	1508	2481	5959	85	2.4	13.8
	11/27/75	1900	5.85											14.1
	11/27/75	2300	5.75											16.3
	11/28/75	0300	5.80											18.3
	11/28/75	0700	5.95	1485	544	48	64	64	1226	2971	6402	67	9.5	17.1
	11/28/75	1100	5.80											15.3
	11/28/75	1500	5.90	1370	411	49	56	56	1247	3226	6415	72	-11.9	14.1
	11/28/75	1900	5.85											13.5
	11/28/75	2300	5.65											13.2
	11/29/75	0300	5.70											13.6
	11/29/75	0700	5.75	1780	532	46	51	88	1946	2671	7114	112	13.1	13.3
	11/29/75	1100	5.85											14.2
	11/29/75	1500	5.95	1710	453	46	54	68	1314	2765	6430	91	14.6	14.3
	11/29/75	1900	5.90											14.1
	11/29/75	2300	5.75											15.8
	11/30/75	0300	5.80											15.7
	11/30/75	0700	5.80	1055	598	48	56	64	1053	2907	5781	48	-0.1	17.2
	11/30/75	1100	6.00											18.0
	11/30/75	1500	5.85	1020	583	46	69	136	945	2269	5068	43	15.2	18.0
	11/30/75	1900	5.80											18.5
	11/30/75	2300	5.85											17.3
	12/01/75	0300	5.85											19.9
	12/01/75	0700		964	576	43	70	70	1144	2446	5313	50	4.6	
	12/01/75	1100	6.00											18.7
	12/01/75	1500	5.85	956	565	41	66	118	1017	2375	5138	45	6.7	17.7
	12/01/75	1900	5.90											18.4
	12/01/75	2300	5.90											19.2
	12/02/75	0300	5.90											17.0

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
566-2A	12/02/75	0700	6.00	844	510	46	58	168	658	2375	4659	29	3.0	17.5
	12/02/75	1100	5.95											18.4
	12/02/75	1500	5.95	784	547	40	63	88	798	2198	4518	33	7.6	16.4
	12/02/75	1900	5.85											15.7
	12/02/75	2300	5.95											16.2
	12/03/75	0300	5.90											15.9
	12/03/75	0700	5.90	1100	386	39	50	72	1582	1879	5108	83	2.1	15.0
	12/03/75	1100	5.95											16.0
567-2A	12/03/75	1500	5.85											15.8
	12/03/75	1900	5.85											16.4
	12/03/75	2300	6.00											16.2
	12/04/75	0300	5.95											17.1
	12/04/75	0700	5.95	584	307	32	50	112	608	1524	3217	28	-2.4	18.5
	12/04/75	1100	6.00											18.5
	12/04/75	1500	6.00	682	379	33	55	112	792	1666	3719	35	2.6	17.1
	12/04/75	1900	5.95											17.5
	12/04/75	2300	6.05											16.7
	12/05/75	0300	6.00											16.7
	12/05/75	0700	6.00	618	392	36	50	192	803	1595	3686	34	-0.9	16.8
	12/05/75	1100	6.05											16.4
	12/05/75	1500	6.05	655	447	38	56	80	937	1843	4056	38	-1.3	14.5
	12/05/75	1900	6.00											12.9
	12/05/75	2300	5.97											16.0
	12/06/75	0300	5.97											16.7
	12/06/75	0700	5.87	920	371	36	54	24	843	2269	4517	44	-3.5	15.7
	12/06/75	1100	5.94											15.4
	12/06/75	1500	5.88	1080	429	43	54	80	700	2410	4796	38	8.5	16.4
	12/06/75	1900	6.00											15.5
	12/06/75	2300	6.05											17.0
	12/07/75	0300	5.95											17.3
	12/07/75	0700	6.02	820	448	44	54	48	544	2375	4333	25	1.9	17.1
	12/07/75	1100	5.98											16.2
	12/07/75	1500	5.97	1140	380	51	59	40	597	2410	4677	34	11.4	19.3
	12/07/75	1900	6.00											19.5
	12/07/75	2300	6.06											20.3
	12/08/75	0300	6.03											19.6
	12/08/75	0700	5.98	980	418	43	56	48	609	2056	4210	32	17.0	19.0
	12/08/75	1100	5.93											20.7
	12/08/75	1500	5.94	727	501	49	55	64	558	2020	3973	23	13.3	21.1
	12/08/75	1900	5.95											20.3
	12/08/75	2300	6.04											20.7
	12/09/75	0300	6.02											17.0
	12/09/75	0700	5.99	812	473	39	56	56	1075	2020	4531	47	2.2	17.5
568-2A	12/09/75	1600	5.86	945	496	43	57	32	1479	1915	4967	67	6.2	14.7
	12/09/75	1900	5.70											13.9
	12/09/75	2300	5.63											14.5
	12/10/75	0300	5.58											14.4
	12/10/75	0700	5.59	762	438	37	55	144	1267	1773	4476	54	-3.8	15.0
	12/10/75	1100	5.59											15.2
	12/10/75	1500	5.47	866	476	23	62	136	1566	1843	4972	68	-3.6	14.4

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
568-2A	12/10/75	1900	5.43											12.4
	12/10/75	2300	5.61											13.6
	12/11/75	0300	5.63											13.3
	12/11/75	0700	5.56	705	418	32	55	152	1479	1631	4472	61	-11.4	14.6
	12/11/75	1100	5.58											14.5
	12/11/75	1500	5.63	677	422	33	53	152	1454	1595	4386	58	-10.9	14.3
	12/11/75	1501	5.63											14.0
	12/11/75	1900	5.51											14.1
	12/11/75	2300	5.63											14.0
	12/12/75	0300	5.49											11.9
	12/12/75	0700		1512	433	410	52	104	2471	2481	7463	137	4.8	
	12/12/75	0701												11.1
	12/12/75	0702	5.42											11.0
	12/12/75	1100	5.46											13.3
	12/12/75	1500	5.65	1421	41	50	52	192	1644	2162	5562	127	-28.6	13.9
	12/12/75	1900	5.54											13.7
	12/12/75	2300	5.43											12.6
	12/12/75	2301												12.6
	12/13/75	0300	5.52											12.9
	12/13/75	0700	5.45	896	462	43	62	112	1471	1453	4499	66	13.7	12.9
	12/13/75	1100												12.9
	12/13/75	1500		1086	571	48	55	64	2023	1595	5442	98	15.2	
	12/13/75	1502	5.56											12.6
	12/13/75	1900	5.50											11.7
	12/13/75	2300	5.61											12.4
	12/14/75	0300	5.45											12.2
	12/14/75	0700	5.49	856	458	47	53	128	1964	1666	5172	84	-8.7	12.4
	12/14/75	1100	5.52											12.3
	12/14/75	1500		875	438	48	55	104	1984	1595	5099	87	-6.9	11.9
	12/14/75	1902												11.0
	12/14/75	2300	5.56											11.8
	12/14/75	2301	5.56											11.7
	12/15/75	0300	5.46											11.1
	12/15/75	0700	5.52	1032	459	44	19	28	2244	1708	5533	194	-4.4	13.4
	12/15/75	1100	5.51											13.7
	12/15/75	1500	5.59	917	423	41	68	208	2004	1843	5504	91	-17.6	14.2
	12/15/75	1501	5.59											14.1
	12/15/75	1900	5.44											12.9
	12/15/75	2300	5.61											12.9
	12/15/75	2301	5.51											12.6
	12/16/75	0300	5.62											14.4
	12/16/75	0700	5.53											13.8
	12/16/75	0701	5.53											13.8
569-2A	12/16/75	1500	4.88	1555	443	47	65	952	3847	1489	8398	201	-23.9	
	12/16/75	1501												
	12/16/75	1900	5.64											14.0
	12/16/75	2300	5.47	992	410	35	52	72	2371	1347	5279	110	-3.6	13.6
	12/16/75	2301	5.47											13.8
	12/17/75	0300	5.68											15.5
	12/17/75	0700	5.60	960	432	44	63	176	2095	1524	5294	96	-4.6	14.8

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
569-2A	12/17/75	1100	5.53											15.9
	12/17/75	1500		1658	424	50	50	136	2425	1575	6318	141	10.8	15.2
	12/17/75	1501												15.0
	12/17/75	1900												14.5
	12/17/75	2300												12.8
	12/18/75	0300	5.41											11.9
	12/18/75	0700	5.58	1238	498	55	70	152	2391	2340	6744	117	-11.8	11.8
	12/18/75	1102	5.40											10.9
	12/18/75	1500	5.36	1971	558	54	53	104	2258	3124	8122	132	6.9	10.5
	12/18/75	1900	5.53											12.3
	12/18/75	2300	5.65											12.5
	12/19/75	0300	5.45											11.9
	12/19/75	0700		1194	712	60	102	96	2142	3013	7319	91	-7.0	
569-2B	12/19/75	1500	5.48	1460	444	47	56	24	2087	2588	6706	116	-3.7	12.5
	12/19/75	1900	5.52											11.2
	12/19/75	2300	5.58											11.6
	12/20/75	0300												10.6
	12/20/75	0700	5.48	1320	431	51	61	136	2133	1950	6082	114	2.2	11.6
	12/20/75	1100	5.48											11.5
	12/20/75	1500	5.47	1220	425	33	52	216	2292	1772	6010	117	-4.5	11.0
	12/20/75	1501	5.47											11.2
	12/20/75	1900	5.37											12.2
	12/20/75	2300	5.55											13.3
	12/21/75	0300	5.51											12.7
	12/21/75	0700	5.53	1352	501	49	117	168	2261	1808	6256	116	10.1	13.5
	12/21/75	1100	5.50											13.1
	12/21/75	1500	5.51	1309	473	35	51	208	2290	1772	6137	117	3.9	13.0
	12/21/75	1501	5.51											12.4
	12/21/75	1900	5.36											13.1
	12/21/75	2300	5.51											15.5
	12/22/75	0300	5.60											13.9
	12/22/75	0700	5.50	1262	502	39	67	64	2448	1545	5927	120	10.7	14.8
	12/22/75	1100	5.59											13.0
	12/22/75	1500	5.56	1418	431	37	54	240	2349	1701	6230	128	5.8	9.8
	12/22/75	1501	5.56											9.7
	12/22/75	1900	5.54											9.9
	12/22/75	2300	5.54											11.1
	12/23/75	0300	5.45											10.6
	12/23/75	0700	5.62											12.3
	12/23/75	0701	5.63											12.5
570-2A	12/23/75	1100	5.70											12.4
	12/23/75	1500	5.91	1365	435	37	55	104	1984	1347	5327	108	23.4	14.2
	12/23/75	1501	5.91											14.4
	12/23/75	1900	5.95											14.6
	12/23/75	2300	5.68											14.9
	12/24/75	0300	5.74											15.5
	12/24/75	0700	5.81	1140	475	41	68	32	2101	2056	5913	102	-3.1	15.3
	12/24/75	1100	5.78											14.4
	12/24/75	1500	5.65	1600	454	41	64	104	2695	2127	7085	150	1.6	14.5
	12/24/75	1501	5.65											13.8

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
570-2A	12/24/75	1900	5.78											12.4
	12/24/75	2300	5.76											12.1
	12/25/75	0300	5.75											12.0
	12/25/75	0700	5.79	1280	468	44	75	64	2187	1950	6068	112	3.8	12.3
	12/25/75	1100	5.76											12.5
	12/25/75	1500	5.83	1305	429	40	57	72	2131	2056	6090	113	-0.5	12.2
	12/25/75	1501												12.3
	12/25/75	1900	5.74											14.7
	12/25/75	2300	5.78											15.5
	12/26/75	0300	5.75											15.1
	12/26/75	0700	5.79	1330	499	42	62	32	2561	2020	6546	128	-0.2	14.5
	12/26/75	1100	5.76											14.5
	12/26/75	1500	5.85	1195	521	36	70	72	2267	2020	6181	108	-0.1	15.0
	12/26/75	1900	5.89											14.5
	12/26/75	2300	5.73											12.8
	12/27/75	0300	5.67											12.0
	12/27/75	0700	5.72	1930	576	47	50	64	2177	3013	7857	126	10.3	12.3
	12/27/75	1100	5.78											11.9
	12/27/75	1500	5.71	1595	520	47	67	104	2144	3226	7703	118	-9.6	10.9
	12/27/75	1900	5.71											11.0
	12/27/75	2300	5.61											11.5
	12/28/75	0300	5.67											11.9
	12/28/75	0700	5.83	1635	461	45	67	96	2035	2730	7069	118	1.2	12.6
	12/28/75	1100	5.76											11.7
	12/28/75	1500	5.70	1475	467	44	62	64	2066	2517	6695	114	-0.1	13.1
	12/28/75	1900	5.80											13.8
	12/28/75	2300	5.78											13.7
	12/29/75	0300	5.75											15.0
	12/29/75	0700	5.75	1325	543	46	82	60	2021	2694	6771	101	-4.1	15.3
571-2A	12/29/75	1100	5.58											14.2
	12/29/75	1500	5.68	1540	517	41	68	104	2363	2552	7165	127	-0.7	12.9
	12/29/75	1900	5.79											12.5
	12/29/75	2300	5.89	1615	559	39	61	64	2164	2871	7373	117	1.7	13.3
	12/30/75	0300	5.88											14.8
	12/30/75	0700	5.90											14.3
	12/30/75	0701	5.90											14.4
	12/30/75	1100												13.4
	12/30/75	1500	5.73	1540	489	44	69	80	2153	2623	6998	119	0.0	12.5
	12/30/75	1900	5.71											12.3
	12/30/75	2300	5.68											12.3
	12/31/75	0300	5.80											12.4
	12/31/75	0700	5.86	1650	443	42	56	136	2308	2588	7223	133	-2.0	12.7
	12/31/75	1100	5.84											13.3
	12/31/75	1500	5.83	1605	512	44	67	120	2575	2733	7656	140	-6.2	11.5
	12/31/75	1902	5.83											11.4
	12/31/75	2300	5.87											10.9
	01/01/76	0300	5.79											12.1
	01/01/76	0700	5.74	1780	417	48	59	112	1788	3120	7324	111	-1.0	14.8
	01/01/76	1100												13.0
	01/01/76	1500	5.80	1930	475	50	65	128	1969	3510	8127	121	-2.9	12.4

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
571-2A	01/01/76	1900	5.82											12.5
	01/01/76	2300	5.85											12.5
	01/02/76	0300	5.76											13.9
	01/02/76	0700	5.77	1785	481	48	61	160	1835	3049	7419	110	3.1	14.4
571-2B	01/02/76	1100	5.86											14.2
	01/02/76	1500	6.03											14.2
	01/02/76	1700	5.85											12.5
	01/02/76	1900	5.73											11.2
	01/02/76	2100	4.97											7.9
	01/02/76	2130	4.77											8.4
	01/02/76	2300	5.21											9.8
572-2A	01/03/76	0300	5.15											10.6
	01/03/76	0700	5.43	2215	489	50	58	104	1755	3297	7968	114	14.4	13.2
	01/03/76	1100	5.09											12.1
	01/03/76	1500	5.18	1875	495	48	53	72	1978	3545	8066	119	-3.8	12.4
	01/03/76	1900	5.27											12.7
	01/03/76	2300	5.23											12.7
	01/04/76	0300	5.15											12.7
	01/04/76	0700	5.15	1605	501	47	69	224	1652	3226	7324	94	-4.7	13.9
	01/04/76	1100												13.3
	01/04/76	1500	5.40	1810	507	49	66	136	1996	3297	7861	117	-1.5	12.4
	01/04/76	1900	5.35											14.0
	01/04/76	2300	5.28											12.7
	01/05/76	0300	5.13											10.9
	01/05/76	0700	5.35	1595	488	48	80	211	769	2844	6035	46	18.1	12.6
	01/05/76	1100	5.34											12.4
	01/05/76	1500	5.26	1655	540	50	70	208	2228	2907	7658	123	-2.0	12.6
	01/05/76	1900	5.30											11.6
	01/05/76	2300	5.35	1680	464	44	77	184	2141	2978	7568	124	-5.8	10.9
	01/06/76	0300	5.24											8.5
	01/06/76	0700	5.32											10.1
	01/06/76	0701	5.32											10.2
	01/06/76	1100	5.32											10.6
	01/06/76	1500	5.30	1320	407	48	65	264	1894	2304	6302	104	-7.7	11.1
	01/06/76	1900	5.15											10.4
	01/06/76	2300	5.22	1590	411	39	57	224	1861	2552	6734	111	0.0	11.3
	01/07/76	0300	5.23											11.6
	01/07/76	0700	5.18	1490	499	41	69	200	2211	2591	7101	119	-4.3	11.7
	01/07/76	1100	5.27											10.8
	01/07/76	1500	5.18	1610	469	54	67	384	2171	2942	7697	123	-12.0	9.3
	01/07/76	1900	5.22											9.6
	01/07/76	2300	4.95											7.9
	01/08/76	0300	5.19											12.9
	01/08/76	0700	5.17	1825	513	48	81	248	2173	3226	8114	127	-3.6	12.6
	01/08/76	1100	5.15											13.6
	01/08/76	1500	5.17	1870	525	52	61	424	2123	2978	8033	125	1.1	11.2
	01/08/76	1900	5.25											9.0
	01/08/76	2300	5.30											8.9
	01/09/76	0300	5.29											9.0
	01/09/76	0700	5.19	2155	483	50	73	128	1954	4077	8920	125	-5.0	10.3

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
573-2A	01/09/76	1100	5.56											
	01/09/76	1500		2375	647	54	71	144	1724	3616	8631	107	19.6	12.0
	01/10/76	0700		1970	577	62	81	104	1962	3900	8656	115	-1.9	
	01/10/76	1500		2300	625	63	76	72	2168	4148	9452	131	4.1	
573-2B	01/13/76	0800	5.93	1345	509	61	104	104	790	2978	5891	44	9.9	
	01/13/76	1200		1180	523	51	102	152	449	2978	5435	24	9.0	17.9
	01/13/76	1230	5.88											
	01/13/76	1260	5.88											
	01/13/76	1300	5.90											20.2
	01/13/76	1330	5.94											16.2
	01/13/76	1400	5.95											
	01/13/76	1430	5.91											16.1
	01/13/76	1500	5.86											
	01/13/76	1530	5.82											14.6
	01/13/76	1600	5.79											
	01/13/76	1630	5.70											14.5
	01/13/76	1700	5.66											
	01/13/76	1730	5.58											13.9
	01/13/76	1800	5.43											
	01/13/76	1830	5.29											12.8
	01/13/76	1900	4.95											
	01/13/76	1930	4.79											12.1
574-2A	01/14/76	0030	5.92											
	01/14/76	0100	5.90											
	01/14/76	0130	5.86											15.9
	01/14/76	0200	5.83											
	01/14/76	0230	5.79											15.3
	01/14/76	0300	5.72											
	01/14/76	0330	5.67											14.5
	01/14/76	0400	5.60											
	01/14/76	0430	5.47											13.5
	01/14/76	0500	5.33											
	01/14/76	0530	5.06											12.0
	01/14/76	0600	4.85											
575-2A	01/15/76	1500	5.68	2070	616	62	80	24	1891	4006	8749	112	3.6	9.4
	01/15/76	1900	5.57											12.5
	01/15/76	2300	5.52											13.9
	01/16/76	0300	5.63											13.6
	01/16/76	0700	5.49	1690	557	56	67	144	1692	3190	7396	95	4.1	13.9
	01/16/76	1100	5.35											14.3
	01/16/76	1500	5.50	1952	583	52	69	136	1629	3190	7611	96	14.8	13.3
	01/16/76	1900	5.52											12.6
	01/16/76	2300	5.26											11.4
	01/17/76	0300	5.56											11.3
	01/17/76	0700	5.53	2320	517	55	67	120	1825	3970	8874	118	5.8	13.4
	01/17/76	1100	5.53											12.8
576-2A	01/17/76	1500	5.69	2390	549	64	59	112	1694	4112	8890	108	6.2	14.0
	01/17/76	1900	5.55											15.7
	01/17/76	2300	5.82											16.2
	01/18/76	0300	5.70											17.9
														14.3

------------LIQUID ANALYSES AT SCRUBBER INLET------------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
576-2A	01/18/76	0700	5.48	2230	547	61	120	200	1645	3864	8667	104	8.5	15.9
	01/18/76	1100	5.58											15.1
	01/18/76	1500	5.76	1965	517	58	70	96	1431	3829	7966	89	3.3	15.9
	01/18/76	1900	5.70											15.7
	01/18/76	2300	5.76											14.2
	01/19/76	0300	5.56											13.5
	01/19/76	0700	5.68	2080'	515	63	63	64	1641	4063	8489	103	0.1	14.8
	01/19/76	1100	5.71											14.9
	01/19/76	1500	5.73	2420	633	67	58	72	1355	4396	9001	86	13.1	14.9
	01/19/76	1900	5.63											14.0
	01/19/76	2300	5.52	1955	552	65	76	32	1490	4112	8282	90	0.8	13.8
	01/20/76	0300	5.84											13.1
	01/20/76	0700	5.81											14.2
	01/20/76	0701	5.81											13.8
	01/20/76	1100	5.69											15.4
	01/20/76	1500	5.55	1670	605	59	72	208	1139	3580	7333	64	5.5	14.9
	01/20/76	1900	5.70											17.2
	01/20/76	2300	5.56	1575	609	64	69	128	1025	3403	6873	56	9.5	18.4
	01/21/76	0300	5.64											15.7
	01/21/76	0700	5.58	1750	534	65	70	152	1768	3545	7884	102	-3.5	12.9
	01/21/76	1100	5.71											12.7
	01/21/76	1500	5.73	2300	471	59	59	128	2078	4148	9243	136	-3.7	11.2
	01/21/76	1900	5.73											15.5
	01/21/76	2300	5.75	1885	473	55	64	40	1554	3970	8041	96	-6.1	15.8
	01/22/76	0300	5.71											15.5
	01/22/76	0301	5.79											15.8
	01/22/76	0355	5.72											
576-2B	01/22/76	0430	5.66											
	01/22/76	0500	5.49											14.2
	01/22/76	0530	5.25											
	01/22/76	0600	4.95											10.9
	01/22/76	0630	4.80											
577-2A	01/22/76	1900	5.48											15.9
	01/22/76	2300	5.75											16.0
	01/23/76	0300	5.79											18.3
	01/23/76	0700	5.81	1560	480	68	74	32	1195	3403	6812	78	0.4	19.3
	01/23/76	1100	5.81											18.7
	01/23/76	1500	5.86	1325	429	49	59	24	1102	3226	6213	63	-9.1	16.2
	01/23/76	1900	5.83											16.1
	01/23/76	2300	5.85											15.4
	01/24/76	0300	5.89											15.5
	01/24/76	0700	5.75	1425	458	61	60	64	1312	3403	6783	75	-10.6	15.4
	01/24/76	1100	5.84											15.7
	01/24/76	1500	5.85	1420	498	49	65	56	1223	3368	6679	68	-5.4	15.3
	01/24/76	1900	5.77											13.3
	01/24/76	2300	5.76											13.4
	01/25/76	0300	5.71											16.0
	01/25/76	0700	5.67	2250	510	67	55	48	1808	4219	8957	116	0.4	17.0
	01/25/76	1100	5.71											16.7
	01/25/76	1500	5.71	1675	501	63	61	64	1372	3864	7600	81	-7.8	16.5

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RLA NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
577-2A	01/25/76	1900	5.84											16.6
	01/25/76	2300	5.83											16.9
	01/26/76	0300	5.84											15.5
	01/26/76	0700	5.93	2250	550	53	66	88	1581	3545	8113	101	15.9	15.1
	01/26/76	1100	5.64											15.0
	01/26/76	1500	5.84	1550	556	54	66	64	1233	3829	7352	69	-6.4	17.1
	01/26/76	1900	5.79											18.1
	01/26/76	2300	5.86											17.9
	01/27/76	0300	5.82											18.2
	01/27/76	0700	5.52											19.6
	01/27/76	0701	5.52											20.0
	01/27/76	1100	5.56											18.9
	01/27/76	1500	6.21	1365	572	50	62	64	1213	3510	6836	63	-5.8	15.8
	01/27/76	1900	5.81											16.2
	01/27/76	2300	5.85											17.5
	01/28/76	0300	5.95											18.9
	01/28/76	0700	5.88	1275	509	53	55	248	1030	3084	6254	55	-5.0	18.3
	01/28/76	1100	5.99											17.0
	01/28/76	1500	5.87	1200	596	47	70	72	1145	3155	6275	56	-2.4	16.7
	01/28/76	1900	5.90											16.3
	01/28/76	2300	6.00											16.2
	01/29/76	0300	5.95											14.5
	01/29/76	0700	5.93	1385	499	55	59	96	1273	3261	6628	70	-6.0	15.0
578-2A	01/29/76	1600	5.97											16.6
	01/29/76	1630	5.93											
	01/29/76	1700	5.90											17.1
	01/29/76	1730	5.89											
	01/29/76	1800	5.86											16.8
	01/29/76	1830	5.81											
	01/29/76	1900	5.75											16.1
	01/29/76	1901	5.75											
	01/29/76	1930	5.71											
	01/29/76	2000	5.57											15.6
	01/29/76	2030	5.36											
	01/29/76	2100	5.04											12.2
	01/29/76	2145	5.68											
579-2A	01/29/76	2300	5.39											13.6
	01/30/76	0300	5.08											13.3
	01/30/76	0700	5.12	1665	545	56	66	272	2154	3084	7842	119	-5.0	13.1
	01/30/76	1100	5.25											13.1
	01/30/76	1540	5.35	1575	591	50	64	256	2272	3261	8079	118	-10.8	12.3
	01/30/76	1900	5.24											11.0
	01/30/76	2330	5.19											11.7
	01/31/76	0300	5.26											10.8
	01/31/76	0380	5.26											10.8
	01/31/76	0700	5.26	1435	471	37	59	248	2142	2481	6873	116	-6.4	10.3
	01/31/76	1100	5.32											10.8
	01/31/76	1530	5.23	1590	557	41	57	608	2364	2446	7663	126	-3.9	10.6
	01/31/76	1900	5.19											12.5
	01/31/76	2300	5.30											13.3

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
579-2A	02/01/76	0300	5.23											11.2
	02/01/76	0700	5.16	1480	483	38	59	632	2059	2446	7197	112	-9.3	10.9
	02/01/76	1100	5.38											10.0
580-2A	02/01/76	1530	5.86	1415	509	39	63	320	2595	2410	7351	133	-12.3	12.5
	02/01/76	1900	5.87											12.4
	02/01/76	2055	5.76											
	02/01/76	2130	5.67											
	02/01/76	2200	5.48											12.4
	02/01/76	2230	5.29											
	02/01/76	2315	4.80											
581-2A	02/04/76	2330	4.98											12.3
	02/05/76	0330	5.42											12.9
	02/05/76	0730	5.57	1025	433	28	53	136	2121	1701	5497	100	-6.9	14.5
	02/05/76	1130	5.45											14.4
	02/05/76	1530	5.44	1145	391	36	55	67	2597	1099	5390	130	6.0	14.0
	02/05/76	1930	5.58											13.9
	02/05/76	2330	5.66											11.0
	02/06/76	0330	5.69											10.1
	02/06/76	0730	5.62	1655	405	39	53	11	2231	2800	7194	133	-5.7	10.0
	02/06/76	1130	5.60											10.7
	02/06/76	1530	5.52	1730	435	42	52	45	2210	3332	7846	131	-12.6	12.0
	02/06/76	1930	5.40											13.1
	02/06/76	2330	5.45											13.2
	02/07/76	0330	5.34											12.4
	02/07/76	0730		1970	475	48	52	113	1969	3797	8424	122	-7.2	13.2
	02/07/76	1130												13.6
	02/07/76	1530		2165	481	43	53	45	2091	3900	8784	133	-2.4	12.7
	02/07/76	1930												12.1
	02/07/76	2330												12.4
	02/08/76	0330												11.7
	02/08/76	0730		2430	487	53	66	111	1872	4786	9811	125	-6.7	12.0
	02/08/76	1130												11.1
	02/08/76	1530	5.60	2700	515	41	73	45	2150	4502	10026	145	4.4	11.3
	02/08/76	1930	5.70											11.3
	02/08/76	2330												11.2
	02/09/76	0330												11.3
	02/09/76	0730	5.60	1965	499	52	78	242	2075	3591	8502	126	-5.0	11.2
	02/09/76	1130	5.62											10.6
	02/09/76	1530	5.42	1900	512	54	77	45	2091	3616	8295	124	-3.8	11.5
	02/09/76	1930	5.24											14.5
	02/09/76	2330	5.25											14.4
	02/10/76	0330	5.15											14.3
	02/10/76	0730	5.19											14.4
	02/10/76	1130	5.50											14.4
	02/10/76	1530	5.21	1800	516	46	71	67	2282	3474	8256	131	-5.1	13.2
	02/10/76	1930	5.28											11.2
	02/10/76	2330	5.33											12.4
	02/11/76	0330	5.30											12.9
	02/11/76	0730	5.42	2245	535	43	65	316	1626	4538	9368	104	-6.4	13.3
	02/11/76	1130	5.56											12.9

-----------LIQUID ANALYSES AT SCRUBBER INLET-----------

RUN NUMBER	DATE	TIME	PH AT SCRUBBER INLET	CA++ PPM	MG++ PPM	NA+ PPM	K+ PPM	SO3-- PPM	SO4-- PPM	CL- PPM	TOTAL IONS PPM	SULFATE SAT. AT 50 C	LIQUID IONIC IMBAL. %	MAKE PER PASS M.MOL/L
582-2A	02/11/76	1530	5.35	2579	549	46	74	22	1840	3900	9010	122	16.3	13.7
	02/11/76	1930	5.88											13.4
	02/12/76	0100	5.88											14.9
	02/12/76	0130	5.86											
	02/12/76	0200	5.86											14.6
	02/12/76	0230	5.80											
	02/12/76	0300	5.40											14.0
	02/12/76	0330	5.27											
	02/12/76	0400	5.17											14.1
	02/12/76	0430	4.68											
	02/12/76	0500	5.09											12.9
	02/12/76	0530	4.94											
	02/12/76	0600	4.81											11.2
	02/12/76	0630	4.77											
	02/12/76	0700												9.7
	02/12/76	0710	4.68											

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
546-2A	06/06/75	2300	2760	345	86.2	32.30	16.10	6.66	26.80	9.59	15.1	5.12	24.9	1.65	4.0
	06/07/75	0700	2760	320	87.2	28.30	20.90	4.98	31.10	6.06	16.2	6.46	16.0	1.35	-4.3
	06/07/75	1500	1880	220	87.1	27.20	25.50	1.93	33.80	3.25	11.2	4.96	5.7	1.17	-2.3
	06/07/75	2300	2000	230	87.3	24.10	17.50	5.03	26.90	3.75	11.5	5.67	18.7	1.25	2.0
	06/08/75	0700	3520	490	84.6	25.60	21.40	5.35	32.10	3.28	13.3	5.92	16.7	1.19	-4.2
	06/08/75	1500	2800	550	78.2	26.40	23.50	4.03	33.40	3.00	16.5	7.25	17.1	1.16	-3.1
	06/08/75	2300	3240	920	68.5	25.60	23.10	3.73	32.60	2.92	14.3	6.47	11.4	1.16	-3.7
	06/09/75	0700	3360	1100	63.7	24.30	20.80	5.00	31.00	2.90	13.8	6.51	16.1	1.17	-4.6
	06/09/75	1500	3680	1250	62.3	26.00	24.80	3.40	34.40	2.00	14.2	6.40	9.9	1.11	-2.5
	06/09/75	2300	2880	600	76.9	27.60	22.70	5.93	34.30	3.68	15.4	6.17	17.3	1.20	-4.0
	06/10/75	0700	2840	700	72.7	26.90	21.70	6.28	33.40	3.82	13.1	5.37	18.8	1.21	-5.1
	06/10/75	1500	2720	740	69.9	27.10	23.50	4.83	34.20	3.25	15.1	6.27	14.1	1.17	-3.7
	06/10/75	2300	2280	740	64.0	24.90	22.50	4.18	32.30	2.50	14.1	6.51	12.9	1.14	-3.7
	06/11/75	0700	2120	600	68.6	24.60	20.20	4.05	29.30	2.05	14.2	7.05	13.8	1.13	6.0
	06/11/75	1500	2320	720	65.6	23.90	19.10	3.43	27.30	2.55	14.9	7.67	12.6	1.17	6.4
	06/11/75	2300	2800	760	69.9	25.90	20.30	5.73	31.10	3.62	15.2	6.68	18.4	1.21	-1.9
	06/12/75	0700	3160	880	69.1	25.80	22.10	4.38	32.00	3.78	15.9	7.04	13.7	1.21	-5.5
	06/12/75	1500				26.40	22.70	4.43	32.80	3.10	16.3	7.16	13.5	1.17	-2.0
	06/12/75	2300	3280	600	79.7	26.80	21.00	7.35	33.60	4.15	14.5	5.74	21.9	1.22	-7.6
	06/13/75	0700	3280	680	77.0	26.80	23.20	8.50	37.50	2.00	14.4	5.49	22.7	1.10	-7.5
	06/13/75	1500	3120	380	86.5	29.10	23.20	5.30	34.30	4.68	16.1	6.06	15.5	1.25	-3.1
	06/13/75	2300	3240	340	88.4	30.30	22.40	6.90	34.90	5.46	14.9	5.11	19.8	1.28	-3.6
	06/14/75	0700	3200	300	89.6	30.00	22.70	6.13	34.50	5.95	15.4	5.34	17.8	1.31	-5.8
	06/14/75	1500	2960	420	84.3	28.40	26.00	1.91	34.40	3.49	15.8	6.68	5.5	1.18	-0.5
	06/14/75	2300	3520	540	83.0	29.40	23.90	5.13	35.00	4.98	15.0	5.52	14.7	1.26	-5.0
	06/15/75	0700	3360	440	85.5	30.50	22.00	6.30	33.80	5.90	15.6	5.44	18.7	1.32	-2.3
	06/15/75	1500	2600	260	89.0	30.50	23.20	4.80	33.80	5.96	15.2	5.44	14.2	1.32	-2.5
	06/15/75	2300	2640	340	85.8	32.60	18.30	7.13	30.00	5.91	14.3	4.97	23.8	1.36	12.4
	06/16/75	0700	3000	440	83.8	32.50	18.00	7.20	29.70	9.55	15.1	4.70	24.3	1.58	-1.5
	06/16/75	1500	3120	560	80.1	31.30	20.60	7.15	32.90	7.12	15.0	4.91	21.7	1.39	-2.6
	06/16/75	2300	3280	660	77.7	30.60	20.00	7.60	32.60	8.46	16.0	5.12	23.3	1.47	-9.9
	06/17/75	0700	3680	800	75.9	30.20	26.10	3.58	36.20	5.21	15.6	5.65	9.9	1.26	-5.9
547-2A	06/18/75	1500	2440	300	86.4	30.10	24.70	4.33	35.20	5.34	14.3	5.19	12.3	1.29	-4.5
	06/18/75	2300	2400	360	83.4	31.10	22.30	3.83	31.70	7.89	13.7	4.87	12.1	1.45	-3.7
	06/19/75	0700	3680	590	82.3	31.10	21.10	4.43	30.80	7.11	15.9	5.79	14.4	1.42	1.5
	06/19/75	1500	3320	560	81.3	30.50	23.60	3.50	33.00	6.36	15.4	5.68	10.6	1.35	-2.4
	06/19/75	2300	3240	620	79.8	30.60	25.30	3.88	35.50	6.02	13.5	4.73	10.9	1.31	-6.3
	06/20/75	0700	3480	600	80.9	30.90	24.30	3.83	34.20	7.11	14.3	4.97	11.2	1.38	-6.8
	06/20/75	1500	3040	500	81.9	32.10	24.50	4.08	34.70	7.21	14.4	4.72	11.8	1.38	-4.3
	06/20/75	2300	3280	560	81.1	32.10	23.20	5.50	34.50	7.08	14.8	4.75	16.0	1.37	-3.4
	06/21/75	0700	2800	400	84.2	30.30	23.40	3.05	32.30	6.26	15.3	5.84	9.5	1.35	-1.0
	06/21/75	1500	3200	690	76.5	30.30	15.50	6.53	25.90	8.26	16.3	6.18	25.2	1.59	5.4
	06/21/75	2300	3320	560	81.3	30.10	22.30	2.83	30.70	7.21	14.9	5.76	9.2	1.43	-2.0
	06/22/75	1500	3120	500	82.3	31.10	21.30	4.68	31.30	7.76	15.4	5.45	14.9	1.45	-2.3
	06/22/75	2300	3080	600	78.4	31.60	23.00	3.25	32.00	7.98	14.5	5.09	10.2	1.45	-3.1
	06/23/75	0700	3400	650	78.8	31.10	22.30	4.03	31.90	8.48	15.2	5.24	12.6	1.48	-6.6
548-2A	06/23/75	2300	2520	300	86.8	33.30	18.80	3.80	27.30	11.49	13.7	4.50	13.9	1.77	-1.4
	06/24/75	1500	2760	400	84.0	32.50	18.40	3.80	26.80	11.30	14.5	4.93	14.2	1.77	-2.1
	06/25/75	1500	2960	490	82.1	32.30	20.90	5.68	31.80	10.24	12.2	3.69	17.9	1.59	-9.4
	06/25/75	2300	2320	360	82.8	31.20	24.70	3.13	34.00	7.74	11.1	3.81	9.2	1.41	-7.9
	06/26/75	1500	2240	420	79.2	30.30	19.90	4.93	29.80	8.99	11.4	4.04	16.5	1.55	-6.7

-SOLID ANALYSES AT SCRUBBER INLET-

RLA NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
548-2A	06/26/75	2300	2920	680	74.2	29.20	21.10	3.83	30.20	6.89	12.1	4.77	12.7	1.42	-2.5
	06/27/75	0700	2560	520	77.5	28.80	19.40	3.15	27.40	7.37	12.6	5.27	11.5	1.49	0.7
549-2A	06/27/75	1500				29.40	18.20	5.65	28.40	8.90	12.8	4.77	19.9	1.57	-6.2
	06/27/75	2300	2080	400	78.7	29.50	19.50	3.73	28.10	7.80	13.4	5.35	13.3	1.50	-0.4
	06/28/75	0700	2240	460	77.3	28.80	18.60	2.95	26.20	7.45	14.3	6.11	11.3	1.52	3.3
	06/28/75	1500	2240	440	78.2	29.40	19.30	3.16	27.30	6.43	15.0	6.34	11.6	1.43	7.1
	06/28/75	2300	2600	580	75.3	29.90	18.50	4.08	27.20	7.85	14.8	5.86	15.0	1.52	2.8
	06/29/75	0700	2760	680	72.7	29.30	18.60	4.25	27.50	7.64	15.4	6.19	15.5	1.51	1.0
	06/29/75	1500	2880	700	73.1	29.00	20.00	2.20	27.20	6.77	15.7	6.73	8.1	1.45	4.6
	06/30/75	0700	2640	580	75.7	35.30	16.90	7.18	28.30	9.21	14.1	4.23	25.4	1.59	10.6
	06/30/75	1600	3160	780	72.7	33.80	21.40	4.55	31.30	8.20	15.6	5.05	14.6	1.48	4.2
	06/30/75	2300	3120	680	75.9	34.60	23.50	2.53	31.90	7.00	15.1	5.16	7.9	1.40	9.6
	07/01/75	1500	2400	520	76.0	34.10	21.50	3.33	30.20	7.47	15.5	5.33	11.0	1.45	10.0
	07/01/75	2300	2600	600	74.4	32.70	19.80	4.75	29.50	7.59	14.7	5.16	16.1	1.47	7.2
550-2A	07/02/75	2300	2200	420	78.9	33.20	18.40	10.90	33.90	8.42	12.5	3.26	32.2	1.45	-3.8
	07/03/75	1500	2080	440	76.6	33.60	18.50	5.58	28.70	6.72	13.3	4.66	19.4	1.43	14.7
	07/03/75	2300	2080	440	76.6	31.80	14.40	13.10	31.10	8.01	15.1	4.27	42.1	1.47	-0.6
	07/04/75	1500	2680	620	74.4	30.60	16.40	6.30	26.80	9.60	15.7	5.66	23.5	1.65	-1.3
	07/04/75	2300	3160	700	75.5	36.90	18.20	7.55	30.30	10.02	15.7	4.09	24.9	1.60	7.9
	07/05/75	0700	2360	400	81.2	35.00	19.30	3.38	27.50	9.42	16.1	5.37	12.3	1.62	10.7
	07/05/75	1500	2280	500	75.7	29.00	19.60	4.50	29.00	7.58	14.6	5.74	15.5	1.48	-3.4
	07/05/75	2300	2720	580	76.4	29.20	17.80	9.55	31.80	7.74	15.3	5.13	30.0	1.44	-10.1
	07/06/75	1500	2840	560	78.2	32.70	19.40	3.75	28.00	9.31	15.4	5.45	13.4	1.60	3.7
	07/06/75	2300	3240	840	71.3	33.00	19.50	4.23	28.60	7.90	16.0	5.86	14.8	1.50	8.8
	07/07/75	1600	3040	750	72.7	32.80	23.00	3.35	32.10	7.53	15.1	5.19	10.5	1.43	2.2
	07/07/75	2300	2880	640	75.4	31.30	21.20	4.10	30.60	7.90	14.6	5.25	13.4	1.47	-0.6
551-2A	07/08/75	1500				30.80	21.70	4.28	31.40	8.75	14.0	4.90	13.6	1.51	-7.6
	07/08/75	2300	3040	640	76.7	34.30	21.50	3.33	30.20	9.44	14.3	4.62	11.0	1.57	3.3
	07/09/75	1500	3080	680	75.5	33.80	24.80	3.00	34.00	7.80	14.3	4.58	8.8	1.42	0.1
	07/09/75	2300	3120	700	75.1	33.40	20.20	4.55	29.80	9.02	14.8	4.90	15.3	1.55	3.1
552-2A	07/10/75	2300	2960	360	86.6	31.70	18.40	7.60	30.60	9.24	15.5	4.92	24.8	1.55	-4.8
	07/11/75	1500	2760	360	85.6	30.90	22.00	5.90	33.40	5.90	15.4	5.43	17.7	1.32	0.0
	07/11/75	2300	2640	400	83.2	28.70	18.00	1.90	24.40	7.50	14.5	6.54	7.8	1.56	7.1
	07/12/75	0700	2680	420	82.7	30.00	21.70	3.88	31.00	6.46	14.6	5.64	12.5	1.38	0.2
	07/12/75	1500	3320	560	81.3	31.60	21.10	3.13	29.50	8.36	15.7	5.76	10.6	1.52	0.9
	07/12/75	2300	3280	400	86.5	31.60	22.50	3.58	31.70	6.84	15.2	5.48	11.3	1.39	2.8
	07/13/75	1500	3240	520	82.2	32.30	23.70	4.58	34.20	7.53	15.4	5.01	13.4	1.40	-3.9
	07/13/75	2300	3400	540	82.4	33.60	25.20	1.41	32.90	6.69	14.8	5.25	4.3	1.37	6.0
553-2A	07/19/75	2300	2080	280	85.1	29.20	17.70	4.98	27.10	8.53	14.2	5.57	18.4	1.57	-2.2
	07/20/75	1500	2520	620	72.7	24.50	13.30	5.68	22.30	5.86	16.0	7.92	25.5	1.48	5.8
	07/20/75	2300	2680	440	81.8	29.80	17.90	5.43	27.80	7.42			19.5	1.49	2.9
554-2A	07/25/75	2300	3080	600	78.4	26.40	17.90	0.73	23.10	7.57			3.2	1.60	2.2
	07/26/75	0700	3060	540	80.6	30.50	16.60	4.85	25.60	9.80	15.3		19.0	1.70	0.3
	07/26/75	1500	2680	460	81.0	29.70	18.20	3.95	26.70	9.78	14.9		14.8	1.67	-4.9
	07/26/75	2300	2920	620	76.5	29.10	18.30	3.13	26.00	8.66			12.0	1.61	-0.5
	07/26/75	2301	2840	590	77.0	29.10	18.30	3.13	26.00	8.66			12.0	1.61	-0.5
	07/27/75	0700	3000	620	77.1	30.20	17.90	3.73	26.10	9.15			14.3	1.64	0.9
	07/27/75	1500	3120	760	73.0	28.40	16.50	4.88	25.50	10.52			19.1	1.75	-10.1
	07/27/75	2300	1880	260	84.7	28.10	15.60	8.20	27.70	7.50			29.6	1.49	-3.1
555-2A	07/29/75	2300	2320	490	76.6	28.70	15.80	4.05	23.80	8.77	13.9	5.86	17.0	1.67	3.0
	07/30/75	1500	2880	720	72.3	29.00	16.80	3.90	24.90	8.82	15.0	6.20	15.7	1.64	1.1

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
555-2A	07/30/75	2300	2520	500	78.0	29.40	17.90	3.73	26.10	9.31	14.9	5.91	[illegible]	1.65	-2.5
	07/31/75	2300	2000	290	84.0	27.40	16.00	6.40	26.40	8.98			24.3	1.62	-9.3
556-2A	07/31/75	1502	2280	400	80.6	30.00	16.40	5.50	26.00	9.35			21.2	1.65	-0.4
	08/01/75	1500	1800	180	89.0	29.10	13.60	9.30	26.30	9.97	13.6		15.4	1.69	-7.0
	08/01/75	2300	1520	190	86.2	26.90	14.20	6.75	24.50	10.03	12.2		17.6	1.74	-11.3
	08/02/75	0700	1480	180	86.6	24.80	16.00	6.60	26.60	8.10	11.2	4.82	24.8	1.55	-16.8
	08/02/75	1500	2040	380	79.4	28.60	17.20	4.30	25.80	7.27	10.8	4.58	16.7	1.51	4.4
	08/02/75	2300	2000	400	77.9	25.30	14.70	6.53	25.30	5.00	11.9	5.54	27.4	1.36	4.8
	08/03/75	0700	2600	600	74.4	25.90	16.70	4.73	25.60	7.99	13.2	5.90	18.5	1.57	-9.0
	08/03/75	1500	1480	160	88.1	26.40	17.10	3.73	25.10	9.43	13.4	5.85	14.9	1.68	-12.1
	08/03/75	2300	1600	180	87.6	26.40	13.20	7.70	24.20	10.51	12.5	5.03	31.8	1.79	-14.9
	08/04/75	1500	3200	820	71.6	27.20	16.30	3.13	23.50	9.31	14.5		13.3	1.72	-4.1
	08/04/75	2300	3840	940	72.9	32.30	15.10	4.43	23.30	9.74	15.4		19.0	1.76	11.0
	08/05/75	0700	3720	880	73.8	31.40	15.70	5.68	25.30	12.50			22.4	1.90	-7.2
557-2A	08/05/75	2300	3600	640	80.3	30.80	17.40	5.05	26.80	11.23	15.6		18.9	1.76	-7.4
	08/06/75	1500	1640	220	85.2	27.40	20.70	2.73	28.60	5.11	13.7		9.5	1.33	3.1
	08/06/75	2300	1640	280	81.1	25.00	20.40	2.00	27.50	4.81			7.3	1.32	-1.6
	08/07/75	1500	1480	260	80.6	22.90	16.30	5.53	25.90	2.89	13.8	7.11	21.3	1.20	4.7
	08/07/75	2300	1360	180	85.4	23.20	16.70	3.63	24.50	3.21	13.5		14.8	1.24	8.4
	08/08/75	0700	1440	220	83.1	27.50	22.90	3.08	31.70	5.05	14.2	6.08	9.7	1.29	-4.1
	08/08/75	1600	3040	640	76.7	27.10	14.80	5.70	24.20	8.50	14.9	6.38	23.6	1.64	-2.5
	08/08/75	2300	3600	820	74.8	30.00	17.40	6.05	27.80	9.09	15.0	5.47	21.8	1.59	-3.5
	08/09/75	0700													
	08/09/75	1500													
	08/09/75	1900	3460	920	70.5	27.80	22.20	3.25	31.00	5.82	15.3		10.5	1.34	-4.8
	08/09/75	2300	3520	900	71.7	28.30	22.30	3.23	31.10	6.77	16.0		10.4	1.40	-7.5
	08/10/75	0700	3120	740	73.7	27.80	18.97	6.59	30.30	5.62	15.8		21.8	1.34	-2.1
	08/10/75	1500	3800	1120	67.3	27.50	21.10	3.33	29.70	6.37	16.2		11.2	1.39	-5.2
	08/10/75	2300	3640	1020	68.9	28.80	23.20	4.20	33.20	7.01	16.0		12.7	1.38	-11.8
	08/11/75	1500	2080	350	81.4	27.80	22.40	4.50	32.50	5.52	14.7	5.89	13.9	1.31	-7.2
	08/11/75	2300	3040	840	69.4	26.30	17.80	6.85	29.10	6.77	15.0	6.19	23.6	1.42	-10.3
	08/12/75	1500	2400	560	74.2	26.50	21.80	5.65	32.90	3.89	15.2	6.37	17.2	1.22	-5.7
	08/12/75	2300	2960	900	66.3	26.80	24.60	4.65	35.40	3.21	15.9	6.53	13.1	1.16	-7.8
	08/13/75	0700				26.10	23.90	3.43	33.30	3.07	15.8		10.3	1.17	-4.4
558-2A	08/15/75	1500	1600	220	84.8	28.10	23.30	6.38	35.50	2.28	14.6	5.77	18.0	1.12	1.2
	08/15/75	2300	1560	240	83.0	25.60	21.10	4.13	30.50	2.88	12.9	6.05	13.5	1.17	2.2
	08/16/75	0700	1360	170	86.2	25.00	19.90	4.63	29.50	2.32	11.3	5.47	15.7	1.14	5.5
	08/16/75	1500	2600	740	68.5	24.20	19.90	5.13	30.00	2.07	12.9	6.22	17.1	1.13	2.3
	08/16/75	2300	1400	180	85.8	24.10	17.10	5.33	26.70	3.87	13.1	6.39	20.0	1.26	1.9
	08/17/75	0700	1160	140	86.7	24.10	18.90	5.78	29.40	2.91	12.6	6.02	19.7	1.18	-0.8
	08/17/75	2300	1040	110	88.3	22.80	14.80	7.10	25.60	2.43	11.8	6.05	27.7	1.17	7.8
	08/18/75	0700	1200	200	81.6	20.10	14.20	4.35	22.10	4.20	11.3	6.36	19.7	1.35	-3.6
	08/18/75	1500	1200	140	87.1	20.40	14.30	3.83	21.70	3.26	11.4	6.59	17.6	1.27	5.0
	08/19/75	1500	3280	960	67.6	26.40	21.50	3.03	29.90	3.74	16.4	7.59	10.1	1.23	2.6
	08/19/75	2300	2840	680	73.5	27.50	20.50	4.08	29.70	5.28	15.1	6.47	13.7	1.32	-0.1
	08/20/75	0700	2380	540	74.9	25.80	17.90	4.53	26.90	5.35	15.0	6.93	16.8	1.36	0.5
	08/20/75	1500	2960	740	72.3	26.30	19.60	2.90	27.40	4.75	16.5	7.79	10.6	1.32	4.0
	08/21/75	0700	3040	660	76.0	26.00	17.50	4.83	26.70	5.68	15.2	6.96	18.1	1.39	0.2
	08/21/75	2300	2240	360	82.2	28.20	21.40	4.45	31.20	5.18	15.2	6.22	14.3	1.30	-0.9
	08/22/75	1500	2360	480	77.5	26.40	17.10	5.33	26.70	5.56	13.9	6.25	20.0	1.38	2.3
	08/22/75	2300	2960	740	72.3	24.90	18.60	2.85	26.10	5.65	15.5	7.51	10.9	1.39	-2.3

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
558-2A	08/23/75	0700	3480	620	80.3	28.10	19.80	3.95	28.70	6.87	16.1	6.71	13.8	1.44	-2.7
	08/23/75	1500													
	08/23/75	1900	2880	560	78.5	28.80	20.40	3.10	28.60	6.41	16.1	6.77	10.9	1.41	2.1
	08/23/75	2300	2880	600	76.9	28.50	18.00	3.70	26.20	8.19	14.3	5.97	14.1	1.57	-1.0
	08/24/75	0700	2480	400	82.1	29.10	18.40	4.00	27.00	8.35	16.0	6.47	14.8	1.56	-1.6
	08/24/75	1500	3320	780	74.0	28.50	18.10	4.26	26.90	9.06	15.9	6.30	15.9	1.61	-6.7
	08/24/75	2300	3640	1040	68.3	28.00	23.30	2.88	32.00	4.10	15.3	6.58	9.0	1.23	1.3
	08/25/75	0700	2640	460	80.7	29.10	21.50	2.83	29.70	7.52	14.2	5.70	9.5	1.46	-4.4
	08/25/75	1500	2560	400	82.7	30.20	19.60	4.20	28.70	6.28	14.5	5.77	14.6	1.40	6.9
	08/26/75	1500	3120	740	73.7	28.60	23.30	2.98	32.10	5.87	14.9	6.02	9.3	1.33	-4.8
	08/26/75	2300	3540	960	69.9	28.70	22.90	5.78	34.40	4.16	15.0	5.73	16.8	1.22	-2.4
	08/27/75	0700	3000	660	75.6	28.70	24.40	4.20	34.70	4.46	15.9	6.19	12.1	1.23	-4.5
	08/27/75	1500	3240	780	73.3	28.80	20.60	5.85	31.60	4.50	15.9	6.29	18.5	1.26	3.2
	08/28/75	0700	2680	400	83.5	30.60	18.50	5.78	28.90	7.30	14.8	5.48	20.0	1.46	3.4
	08/28/75	2300	2700	500	79.5	29.90	20.30	4.93	30.30	5.42	14.6	5.74	16.3	1.33	5.9
	08/29/75	1500	3120	720	74.4	29.50	20.90	4.88	31.00	7.34	15.0	5.63	15.7	1.43	-5.3
	08/29/75	2300	3360	860	71.6	28.60	18.90	4.98	28.60	7.77	14.9	5.91	17.4	1.49	-4.7
	08/30/75	0700	3820	1000	71.0	28.70	20.50	2.88	28.50	4.88	16.1	7.58	10.1	1.31	8.8
	08/30/75	1500	2920	600	77.2	28.80	19.60	2.40	26.90	6.36	15.2	6.68	8.9	1.43	6.4
	08/30/75	2300	2840	560	78.2	29.00	17.10	4.03	25.40	8.67	15.0	6.17	15.9	1.62	0.6
	08/31/75	0700	2800	440	82.6	28.70	17.60	2.80	24.80	7.12	15.0	6.63	11.3	1.52	7.9
	08/31/75	1500	2720	520	78.8	29.10	17.60	3.50	25.50	7.06	15.4	6.63	13.7	1.50	7.7
	09/02/75	0700	2600	280	88.1	28.60	19.60	3.90	28.40	7.43	14.5	5.92	13.7	1.48	-2.7
559-2A	09/05/75	1500	2520	380	83.3	28.70	20.80	3.70	29.70	6.70	13.3	5.40	12.5	1.41	-2.2
	09/06/75	0700	1720	180	88.4	24.50	19.00	3.15	26.90	2.83	13.1	6.69	11.7	1.19	8.4
	09/06/75	1500	3160	490	82.8	24.70	19.00	5.35	29.10	3.51	14.6	6.85	18.4	1.22	-0.6
	09/06/75	2300	2920	500	81.0	27.30	20.70	5.03	30.90	5.37	15.3	6.34	16.3	1.32	-4.3
	09/07/75	0700	2840	400	84.4	27.60	18.90	4.48	28.10	5.70	14.5	6.25	15.9	1.37	2.4
	09/07/75	1500	2400	360	83.4	25.60	19.90	8.03	32.90	2.23	14.8	6.32	24.4	1.12	-1.1
	09/07/75	2300	2440	380	82.8	27.70	17.90	4.13	26.50	5.43	14.7	6.59	15.6	1.37	8.0
	09/08/75	0700	2600	400	83.0	26.90	17.80	3.85	26.10	6.34	13.7	6.19	14.8	1.44	2.0
	09/08/75	1500	3340	700	76.8	27.70	18.40	5.20	28.20	7.30	15.8	6.47	18.5	1.47	-4.9
	09/09/75	2300	3680	780	76.5	29.70	21.50	5.03	31.90	6.62	14.9	5.54	15.8	1.38	-3.6
	09/10/75	0700	3680	760	77.1	29.50	19.20	7.20	31.20	8.33	15.5	5.35	23.1	1.49	-10.1
	09/10/75	1500	3860	960	72.4	29.30	17.50	8.23	30.10	8.05	15.5	5.42	27.3	1.49	-7.0
	09/11/75	0700	3840	980	71.7	29.10	19.50	5.53	29.90	5.92	15.2	6.00	18.5	1.36	2.1
	09/11/75	2300	3920	1000	71.7	29.30	21.90	4.83	32.20	6.54	14.9	5.59	15.0	1.37	-5.4
	09/12/75	1500	3560	820	74.5	29.80	22.70	2.73	31.10	7.19	15.5	6.01	8.8	1.42	-3.8
	09/12/75	2300	3200	700	75.8	29.10	17.00	5.95	27.20	8.65	15.2	5.83	21.9	1.58	-3.4
	09/13/75	0700	2400	440	79.7	28.10	19.30	2.98	27.10	7.28	15.1	6.50	11.0	1.49	-0.6
	09/13/75	1500	3520	860	72.9	28.60	19.30	3.08	27.20	6.78	15.6	6.65	11.3	1.45	3.2
	09/13/75	2300	3560	800	75.1	29.20	20.90	4.08	30.20	6.84	16.1	6.34	13.5	1.41	-2.3
	09/14/75	0700	3480	740	76.4	28.90	17.30	4.98	26.60	8.66	16.3	6.47	18.7	1.59	-2.7
	09/14/75	1500	3280	740	75.0	30.10	20.20	4.35	29.60	8.77	15.9	5.84	14.7	1.54	-6.0
	09/14/75	2300	3960	1060	70.3	29.70	21.10	5.03	31.40	6.71	14.9	5.58	16.0	1.39	-2.8
	09/15/75	0700	4020	1160	68.0	29.60	21.30	3.98	30.60	7.57	15.6	5.89	13.0	1.45	-4.3
	09/15/75	1500	3600	860	73.5	30.80	25.20	2.91	34.40	3.37	15.2	5.95	8.4	1.18	7.8
	09/16/75	0700	3520	840	73.6	30.00	23.20	2.00	31.00	5.79	15.4	6.27	6.5	1.34	3.0
	09/16/75	1500													
	09/16/75	2300	3040	620	77.4	30.30	22.60	2.45	30.70	5.91	14.8	5.96	8.0	1.35	4.2
	09/17/75	0700	2960	660	75.3	29.80	18.00	4.40	26.90	8.54	14.6	5.72	16.4	1.59	0.3

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
559-2A	09/17/75	1500	3040	680	75.2	29.30	21.10	1.93	28.30	6.31	14.8	6.33	6.8	1.41	4.9
	09/18/75	0700	3080	580	79.1	28.70	20.60	3.15	28.90	6.52	15.3	6.44	10.9	1.41	0.5
	09/18/75	2300	1520	200	85.4	25.30	19.70	3.78	28.40	3.49	13.9	6.71	13.3	1.22	3.6
	09/19/75	1500	3400	940	69.4	25.10	16.90	7.28	28.40	3.73	14.1	6.42	25.6	1.24	1.8
	09/19/75	2300	3640	900	72.6	29.30	15.10	5.23	29.10	5.81	15.2	6.28	18.0	1.36	1.6
	09/20/75	0700	3720	900	73.2	28.40	19.10	4.33	28.20	6.59	15.6	6.51	15.4	1.43	0.9
	09/20/75	1500	2960	660	75.3	28.60	21.90	3.53	30.90	5.52	14.8	6.07	11.4	1.32	-0.3
	09/20/75	2300	3720	940	72.0	28.70	22.60	5.85	34.10	5.16	15.5	5.79	17.2	1.28	-6.1
	09/21/75	0700	3880	940	73.2	27.90	15.00	5.65	24.60	8.65	16.2	6.70	23.8	1.64	-1.3
	09/21/75	1500	3400	720	76.5	30.00	21.30	2.88	29.50	8.38	14.8	5.67	9.8	1.52	-4.5
	09/21/75	2300	3240	640	78.1	30.20	20.30	4.33	29.70	5.74	15.2	6.00	14.6	1.35	5.9
	09/22/75	0700				29.70	17.10	5.83	27.20	8.89	15.2	5.72	21.4	1.59	-2.3
560-2A	09/23/75	1500	3120	640	77.3	29.40	19.80	3.05	27.80	7.13	15.5	6.39	11.0	1.47	2.9
	09/23/75	2300	3000	620	77.1	29.00	21.10	3.63	30.00	6.90	15.6	6.26	12.1	1.42	-2.8
	09/24/75	0700	3200	660	77.2	28.10	18.80	4.20	27.70	5.17	16.4	7.19	15.2	1.34	7.5
	09/24/75	1500	3120	600	78.7	28.80	19.90	4.33	29.20	4.99	15.4	6.54	14.8	1.31	6.9
	09/25/75	0700	3680	900	72.9	29.50	12.80	8.30	24.30	9.53	14.9	5.58	34.2	1.71	1.1
	09/25/75	1500	4290	1190	69.3	28.70	21.00	2.45	28.70	7.29	15.8	6.56	8.6	1.46	-2.4
	09/25/75	2300	3640	820	75.0	30.10	23.20	3.30	32.30	7.06	15.1	5.64	10.2	1.40	-5.1
	09/26/75	0700	3360	700	76.9	30.10	20.60	5.15	30.90	7.53	14.6	5.33	16.7	1.44	-3.8
	09/26/75	1500													
	09/27/75	0700													
	09/27/75	1500	3160	560	80.4	32.10	21.30	4.38	31.00	7.54	14.4		14.1	1.44	2.4
	09/27/75	2300	3200	660	77.2	30.70	21.00	2.95	29.20	8.76	14.0		10.1	1.55	-3.0
	09/28/75	0700				30.30	21.30	3.58	30.20	7.78	16.0	6.00	11.9	1.47	-2.5
	09/28/75	1500				31.40	15.30	7.28	26.40	8.32	15.7	5.67	27.6	1.57	7.3
	09/28/75	2300				32.10	18.80	2.70	26.20	8.82	15.0	5.74	10.3	1.61	7.8
	09/29/75	0700	3160	520	81.8	31.60	16.00	4.40	24.40	10.78	9.4	3.45	18.0	1.80	2.4
561-2A	09/30/75	2300	2840	440	82.9	31.70	19.20	4.80	28.80	7.36	15.0	5.51	16.7	1.46	6.8
	10/01/75	0700				31.60	20.70	2.83	28.70	9.09	15.7	5.79	9.9	1.59	-0.3
	10/01/75	1500				30.70	20.90	2.38	28.50	7.99	14.6	5.70	8.3	1.51	1.8
	10/01/75	1501				30.90	21.00	2.55	28.80	8.71	14.6	5.51	8.9	1.55	-1.2
	10/02/75	2300	3080	700	74.8	28.80	22.10	3.28	30.90	7.24	15.0	5.91	10.6	1.43	-7.2
	10/02/75	2301	3200	730	74.7	28.90	21.90	3.63	31.00	7.28	15.0	5.86	11.7	1.43	-7.2
	10/03/75	1500	2120	380	80.2	28.80	24.30	2.03	32.40	5.05	14.4	6.01	6.3	1.28	-1.1
	10/03/75	1501	2120	390	79.6	29.00	24.40	1.80	32.30	6.65	14.4	5.77	5.6	1.37	-7.2
	10/03/75	2300	1920	280	83.3	29.20	19.70	3.78	28.40	7.99	14.1	5.59	13.3	1.51	-3.0
	10/03/75	2301	1920	290	83.3	29.40	20.30	3.53	28.90	8.30	14.1	5.48	12.2	1.52	-4.8
	10/04/75	0700	2880	600	76.9	28.80	22.50	2.98	31.10	4.16	14.8	6.28	9.6	1.24	6.0
	10/04/75	0701	2860	580	77.5	28.90	22.10	3.88	31.50	3.98			12.3	1.23	6.1
	10/04/75	1500	3280	760	74.3	29.60	20.80	5.80	31.80	6.43	15.0	5.56	18.3	1.37	-2.9
	10/04/75	1501	3340	780	74.1	29.70	20.80	5.60	31.60	6.52	15.0	5.55	17.7	1.38	-2.5
	10/04/75	2300	3440	740	76.2	29.70	21.70	4.48	31.60	6.54	14.5	5.49	14.2	1.38	-2.6
	10/05/75	0700	3560	720	77.6	28.70	22.40	5.00	33.00	6.13	15.3	5.78	15.2	1.34	-7.6
	10/05/75	1500	3160	840	70.5	28.90	24.10	2.58	32.70	5.39	14.5	5.87	7.9	1.30	-3.0
	10/05/75	1501	3120	810	71.2	28.90	24.10	2.88	33.00	5.68	14.5	5.79	8.7	1.31	-5.0
	10/05/75	2300	3320	820	72.6	29.20	24.40	2.80	33.30	5.60	15.0	5.89	8.4	1.31	-4.3
	10/05/75	2301	3300	810	72.8	29.30	25.00	2.26	33.50	5.78	15.0	5.92	6.7	1.31	-5.2
	10/06/75	0700	3800	1020	70.3	29.30	23.80	2.65	32.40	5.37	15.1	6.05	8.2	1.30	-0.8
562-2A	10/07/75	2300	3800	1180	65.6	28.80	21.60	3.20	30.20	5.41	14.5	6.06	10.6	1.33	2.6
	10/07/75	2301	3900	1150	67.3	28.90	21.50	3.23	30.10	5.79	14.5	5.99	10.7	1.35	1.5

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
562-2A	10/08/75	0700	3840	1060	69.4	29.50	20.20	4.65	29.90	6.10	14.3	5.65	15.6	1.37	2.7
	10/08/75	0701	3860	1040	70.1	29.60	20.10	5.08	30.20	5.99			16.8	1.36	2.7
	10/08/75	1500	3120	720	74.4	28.90	25.10	2.73	34.10	4.99	15.0	6.00	8.0	1.27	-4.7
	10/08/75	1501	3080	710	74.5	28.90	25.20	2.61	34.10	4.99	15.0	6.01	7.6	1.27	-4.7
	10/08/75	2300	2440	360	83.7	30.60	23.00	3.85	32.60	8.23	14.3	5.00	11.8	1.46	-8.9
	10/08/75	2301	2260	330	83.8	30.60	22.90	3.98	32.60	7.70			12.2	1.43	-6.7
	10/09/75	0700	2800	520	79.4	32.00	19.30	4.98	29.10	9.65	14.4	4.86	17.1	1.60	-2.1
	10/09/75	1100	2680	480	80.2	31.90	21.20	4.50	31.00	7.21	15.2	5.39	14.5	1.42	3.1
	10/09/75	1500	2640	520	78.2	30.50	21.20	3.90	30.40	8.74	14.9	5.39	12.8	1.52	-6.3
	10/09/75	1900	2480	580	74.1	30.50	23.10	2.43	31.30	7.60	14.6	5.50	7.8	1.44	-3.6
	10/09/75	2300	2600	540	77.0	31.00	21.00	4.25	30.50	7.63	15.2	5.53	13.9	1.46	-0.3
	10/10/75	0300	2200	360	81.9	32.00	16.10	5.98	26.10	11.46	14.9	4.98	22.9	1.80	-2.8
	10/10/75	0700	2480	400	82.1	34.50	16.20	4.65	24.90	10.92	14.9	4.99	18.7	1.80	9.1
	10/10/75	1100	2960	520	80.6	35.80	16.50	5.28	25.90	14.42	15.0	4.11	20.4	2.01	-2.0
	10/10/75	1500	2880	520	80.0	33.80	17.10	6.23	27.60	12.00	14.9	4.46	22.6	1.79	-2.4
	10/10/75	1900	3320	700	76.6	30.50	20.30	4.43	29.80	9.11	14.7	5.25	14.9	1.56	-6.5
	10/10/75	2300	3080	600	78.4	30.50	21.80	4.05	31.30	8.47	15.1	5.35	13.0	1.50	-8.1
	10/11/75	0300	3400	700	77.2	31.80	20.00	5.30	30.30	7.32	14.6	5.17	17.5	1.44	3.9
	10/11/75	0700	2840	560	78.2	33.10	18.20	5.35	28.10	8.10	15.1	5.24	19.1	1.52	9.4
	10/11/75	1100	3200	520	82.0	34.10	18.20	6.09	28.80	9.65	15.2	4.73	21.0	1.61	4.8
	10/11/75	1500	3200	600	79.2	33.90	19.70	5.78	30.40	10.38	15.5	4.59	19.0	1.62	-1.8
	10/11/75	1900	3440	600	80.7	34.80	15.10	7.03	25.90	12.31	15.4	4.47	27.1	1.86	2.8
	10/11/75	2300	3360	500	83.5	34.80	17.80	5.65	27.90	9.28	14.8	4.70	20.3	1.61	9.9
	10/12/75	0300	3320	620	79.3	31.60	17.80	10.25	32.50	9.12	14.9	4.25	31.5	1.51	-8.8
	10/12/75	0700	3280	740	75.0	30.40	20.20	7.35	32.60	7.26	15.3	5.13	22.6	1.41	-5.5
	10/12/75	1100	3320	720	76.0	31.10	20.40	7.40	32.90	6.65	14.9	5.03	22.5	1.37	-1.3
	10/12/75	1500	3200	720	75.1	31.60	18.30	10.53	33.40	7.42	15.5	4.54	31.5	1.40	-4.0
	10/12/75	1900	3080	660	76.3	32.00	16.90	9.38	30.50	10.95	14.7	4.17	30.7	1.65	-10.4
	10/12/75	2300	3200	720	75.1	30.50	25.60	4.31	36.30	5.10	14.6	5.17	11.9	1.26	-4.7
	10/13/75	0300	3920	1100	68.9	30.00	27.40	3.66	37.90	4.49	14.5	5.22	9.6	1.22	-7.6
	10/13/75	0700	3640	920	72.0	29.60	20.80	10.40	36.40	4.94	14.6	4.65	28.6	1.24	-7.0
	10/13/75	1100	3600	860	73.5	31.30	22.30	6.03	33.90	4.99	15.9	5.59	17.8	1.27	3.8
	10/13/75	1500	3800	1000	70.8	31.80	19.90	8.08	31.70	8.68	15.8	4.87	25.5	1.50	-4.6
	10/13/75	1900	3640	940	71.4	32.10	22.40	5.90	33.90	5.92	15.3	5.10	17.4	1.32	2.5
	10/13/75	2300	3760	860	74.7	31.90	22.30	4.43	32.30	8.92	15.7	5.17	13.7	1.50	-6.6
	10/14/75	0300	3680	960	71.1	31.30	22.10	6.28	33.90	8.63	15.4	4.80	18.5	1.46	-11.0
	10/14/75	0700	3840	1040	70.0	29.80	20.80	5.30	31.30	7.37	15.4	5.67	16.9	1.43	-5.1
	10/14/75	1500	3360	940	72.3	29.60	24.40	3.30	33.80	6.48	15.7	5.86	9.8	1.35	-7.9
	10/14/75	1900	3120	820	70.9	28.70	25.20	1.31	32.80	5.57	15.8	6.55	4.0	1.31	-4.8
	10/14/75	2300	3120	760	73.0	29.40	22.50	2.98	31.10	6.77	16.6	6.55	9.6	1.40	-3.4
	10/15/75	0300	3280	760	74.3	29.10	21.90	3.13	30.50	6.88	15.1	6.02	10.3	1.41	-3.5
	10/15/75	0700	4900	1260	65.1	28.60	20.00	4.20	29.20	7.22	15.6	6.27	14.4	1.45	-3.7
	10/15/75	1100	3920	1060	70.0	30.30	22.00	2.70	30.20	7.83	15.1	5.76	9.0	1.47	-2.7
	10/15/75	1500	4060	1200	67.2	29.60	24.70	2.43	33.30	6.55	14.6	5.61	7.3	1.36	-7.0
	10/15/75	1900	3320	700	76.6	31.30	21.30	4.38	31.00	9.02	14.6	4.89	14.1	1.53	-6.1
	10/15/75	2300	3120	620	78.0	30.70	23.70	2.38	32.00	8.20	15.3	5.48	7.4	1.47	-7.0
	10/16/75	0300	3120	560	80.1	30.50	22.10	5.58	33.20	8.53	14.7	4.87	16.8	1.47	-11.9
	10/16/75	0700	3040	680	75.2	30.00	19.90	4.83	29.70	7.25	14.5	5.50	16.3	1.44	-0.1
	10/16/75	1100	3060	660	76.1	30.00	20.40	4.40	29.90	7.75	14.7	5.50	14.7	1.47	-2.7
	10/16/75	1500	2920	500	81.0	30.60	22.00	2.60	30.30	6.99	16.0	6.17	9.3	1.42	1.5
	10/16/75	1900	3000	530	81.6	31.80	17.10	7.53	28.90	9.24	15.3	5.00	26.0	1.58	-0.7

-SOLID ANALYSES AT SCRUBBER INLET-

PLA NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSCLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
562-2A	10/16/75	2300	2600	360	85.6	32.00	21.50	2.03	26.90	9.19	14.4	5.28	7.0	1.58	0.1
	10/17/75	0300	2920	400	84.8	31.70	20.10	3.88	29.00	9.46	14.7	5.18	13.4	1.59	-2.1
	10/17/75	0700	2880	560	78.5	28.60	20.80	4.90	30.90	6.76	14.5	5.63	15.9	1.40	-5.8
	10/17/75	1100	3640	900	72.6	28.60	19.80	3.25	28.00	6.96	17.5	7.20	11.6	1.45	0.4
	10/17/75	1500	4050	1100	69.9	29.20	21.00	4.15	30.40	7.74	15.2	5.81	13.7	1.46	-6.7
	10/17/75	1501	4035	1100	59.8	28.90	20.80	4.10	30.10	7.67	15.2	5.89	13.6	1.46	-6.8
	10/19/75	0300	2400	380	82.5	29.50	22.80	2.70	31.20	6.88	14.5	5.71	8.7	1.40	-3.8
	10/19/75	0700	2280	340	83.5	30.00	16.90	5.28	26.40	9.35	14.8	5.57	20.0	1.64	-1.4
	10/19/75	1100	2520	380	83.3	31.00	18.00	4.20	26.70	9.42	14.6	5.47	15.7	1.64	0.9
	10/19/75	1500	2600	360	83.8	33.20	17.00	5.05	26.30	11.38	15.2	4.98	19.2	1.79	0.8
	10/19/75	1900	3000	380	86.0	33.10	17.20	4.80	26.30	11.66	14.5	4.78	18.3	1.81	-0.5
	10/19/75	2300	3160	320	88.8	33.10	17.00	5.55	26.80	10.95	15.4	5.02	20.7	1.74	1.1
	10/20/75	0300	2960	200	92.6	33.10	19.70	4.18	23.80	10.67	11.1	3.60	14.5	1.67	-2.0
	10/20/75	0700	2880	300	89.5	31.60	19.70	3.78	28.40	10.16	15.1		13.3	1.65	-3.9
	10/20/75	1100	2640	360	84.9	30.40	21.30	3.28	29.90	8.70	14.6		11.0	1.54	-6.2
	10/20/75	1500	2520	260	88.6	30.60	19.70	4.68	29.30	8.01	14.0		16.0	1.50	-0.4
	10/20/75	1900	2600	390	83.4	30.90	22.60	2.85	31.10	7.20	15.2		9.2	1.42	-0.2
	10/20/75	2300	2960	460	82.6	31.20	20.80	4.70	30.70	5.78	15.3		15.3	1.34	7.5
	10/21/75	0300	2840	360	86.0	31.30	20.10	4.48	29.60	8.20	15.4		15.1	1.50	0.4
	10/21/75	0700	3060	380	86.4	31.20	18.60	6.05	29.30	6.15	15.5		20.7	1.38	9.1
	10/21/75	1100	2720	320	87.0	30.80	21.30	2.88	29.50	5.40	14.9		9.8	1.33	10.6
	10/21/75	1500	2600	260	89.0	31.40	20.20	4.05	29.30	7.97	15.6	5.75	13.8	1.49	2.3
	10/21/75	1900	2600	260	89.0	32.10	17.40	5.35	27.10	9.38	14.4	5.03	19.8	1.63	3.6
	10/21/75	2300	2360	200	90.6	31.90	20.00	4.60	29.60	8.04	15.5	5.51	15.6	1.49	2.9
	10/22/75	0300	3400	520	83.1	32.40	20.50	5.68	31.30	7.76	15.9	5.28	18.1	1.45	1.8
	10/22/75	0700	3640	400	87.9	33.40	15.60	6.40	25.90	10.35	14.7	4.85	24.7	1.73	6.2
	10/22/75	1100	3800	640	81.4	33.60	19.40	4.65	29.10	11.11	15.8	4.90	16.7	1.69	-2.8
	10/22/75	1500	3400	560	83.7	33.70	22.30	3.53	31.40	8.90	15.1	4.88	11.2	1.52	1.1
	10/22/75	1900	3480	460	85.4	34.80	14.60	8.45	26.70	12.25	15.4	4.23	31.7	1.83	1.4
	10/22/75	2300	3520	440	86.2	33.70	20.10	5.68	30.80	8.18	15.0	4.76	18.4	1.48	5.1
	10/23/75	0300	3480	400	87.3	33.60	23.60	3.40	32.90	7.99	15.0	4.87	10.3	1.44	1.1
	10/23/75	1500	2800	340	86.6	33.90	19.20	5.50	29.50	10.10	15.2	4.69	18.7	1.62	1.1
	10/23/75	1900	2520	380	83.3	32.20	23.80	2.65	32.40	8.42	14.7	5.02	8.2	1.47	-3.8
	10/23/75	2300	2640	480	79.9	30.90	23.10	3.53	32.40	7.26	14.8	5.31	10.9	1.41	-3.4
	10/24/75	0300	2600	420	82.1	30.80	23.10	2.73	31.60	7.86	15.0	5.49	8.6	1.45	-4.4
	10/24/75	0700	2600	300	87.2	33.80	20.40	2.70	28.20	11.57	15.3	4.98	9.6	1.75	-2.1
	10/24/75	1100	2400	220	89.9	37.00	13.30	5.88	22.50	14.20	15.0	4.26	26.1	2.15	8.5
	10/24/75	1500	2420	220	90.0	35.60	17.70	4.48	26.60	10.89	15.0	4.69	16.8	1.74	8.7
	10/24/75	1900	2680	280	98.5	35.00	17.70	4.78	26.90	11.66	15.0	4.57	17.8	1.79	3.7
	10/24/75	2300	2840	300	88.3	34.90	16.90	5.38	26.50	10.54	14.8	4.69	20.3	1.72	8.3
	10/25/75	0300	3000	340	87.5	34.30	17.20	5.00	26.50	12.04	15.4	4.74	18.9	1.83	1.2
	10/25/75	0700	3000	280	89.7	34.80	16.10	4.88	25.00	13.62	15.6	4.68	19.5	1.99	-0.2
	10/25/75	1100	2720	280	88.6	35.50	13.00	6.55	22.80	14.13	15.6	4.52	28.7	2.13	4.3
	10/25/75	1500	2480	260	98.4	33.30	19.40	2.35	26.60	11.06	14.7	5.13	8.8	1.76	1.7
	10/25/75	1900	2120	260	86.4	32.90	16.20	4.35	24.60	10.23	15.0	5.42	17.7	1.76	8.0
	10/25/75	2300	2640	340	85.8	34.00	14.70	4.03	22.40	12.49	15.3	5.27	18.0	2.01	7.0
	10/26/75	0302	3320	470	86.0	36.20				12.10	16.0	6.26			
	10/26/75	0700	3280	360	87.9	40.70	14.00	9.30	26.80	13.70	14.9	2.91	34.7	1.93	11.0
	10/26/75	1100	3000	440	83.9	39.00	11.00	12.05	25.80	12.27	14.0	2.99	46.7	1.87	13.6
	10/26/75	1500	3240	540	81.6	34.40	18.80	4.90	28.40	9.68	14.8	4.74	17.3	1.62	6.3
	10/26/75	1900	3420	380	87.7	35.50	17.20	5.90	27.40	11.72	15.0	4.32	21.5	1.78	3.9

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
562-2A	10/26/75	2300	3520	450	85.9	34.50	17.80	6.55	26.80	10.39	15.6	4.61	22.8	1.66	3.2
	10/27/75	0300	3560	440	86.3	34.10	19.90	4.33	29.20	10.40	15.5	4.87	14.8	1.65	1.2
	10/27/75	0700	3680	500	85.0	34.70	22.30	2.93	30.80	10.62	15.4	4.70	9.5	1.63	-1.2
	10/27/75	1100	3720	540	83.9	34.30	22.20	2.85	30.60	11.06	15.2	4.65	9.3	1.66	-3.6
	10/27/75	1500	3120	360	87.2	34.60	20.90	4.78	30.90	9.24	15.7	4.77	15.5	1.54	3.4
	10/27/75	1900	2960	320	88.1	34.70	17.40	5.15	26.90	10.18	15.1	4.80	19.2	1.59	8.1
	10/27/75	2300	3000	300	89.0	34.80	21.40	3.75	30.50	11.52	15.4	4.61	12.3	1.69	-6.0
	10/28/75	0300	3160	380	86.7	33.10	22.00	2.60	30.10	9.44	14.8	5.01	8.7	1.57	8.0
	10/28/75	0301	3170	350	86.4	31.20	20.70	3.47	29.30	9.43	15.5	5.56	11.7	1.59	-4.3
	10/28/75	0700	3120	400	85.8	32.80	20.50	3.08	28.70	10.10	15.7	5.38	10.7	1.64	-0.5
	10/28/75	1111	3040	360	86.9	33.50	20.70	3.43	29.30	10.52	11.4	3.70	11.7	1.55	-1.3
	10/28/75	1500	2920	340	87.1	33.60	21.00	3.35	29.60	8.91	15.3	5.18	11.3	1.55	4.5
	10/28/75	1900	2920	300	88.6	33.80	20.70	3.33	29.20	10.62	14.4	4.63	11.4	1.66	-0.6
	10/28/75	2300	2880	410	84.2	31.50	20.80	3.20	29.20	10.44	15.4	5.36	11.0	1.65	-7.2
	10/29/75	0700	3000	400	85.3	33.10	18.20	4.05	26.80	12.99	16.0	5.06	15.1	1.88	-6.7
	10/29/75	1100	3200	360	87.6	34.70	18.30	4.93	27.80	12.18	15.3	4.54	17.7	1.80	-0.8
	10/29/75	1500	3080	420	84.9	35.60	17.60	2.40	24.40	14.00	15.4	4.81	9.9	2.04	1.9
	10/29/75	1501	3140	380	86.6	34.90	17.60	3.90	25.90	14.00	15.4	4.57	15.1	1.98	-3.1
	10/29/75	1900	3040	320	88.4	35.40	16.10	4.88	25.00	13.86	16.0	4.66	19.5	2.01	0.6
	10/29/75	2300	3080	320	88.5	36.00	12.50	5.48	21.10	15.24	14.8	4.36	26.0	2.31	5.0
	10/29/75	2301	3040	310	88.7	38.80	12.60	8.65	24.40	15.24	14.6	3.25	35.5	2.14	5.9
	10/30/75	0300	3440	440	85.9	35.20	14.10	5.18	22.80	13.77	14.9	4.60	22.7	2.10	4.8
	10/30/75	0700	3240	340	88.4	35.10	20.00	2.70	27.70	13.01	14.9	4.48	9.8	1.85	-2.5
562-2B	10/30/75	1500	2960	360	86.6	33.40	21.40	3.45	30.20	9.46	14.3	4.71	11.4	1.57	0.6
	10/30/75	1900	2920	420	84.1	31.50	20.60	4.25	30.00	8.97	14.1	4.94	14.2	1.54	-3.0
	10/30/75	2300	2880	480	81.6	30.90	15.30	8.78	27.90	10.55	14.5	4.65	31.5	1.69	-6.8
	10/31/75	0300	2760	440	82.4	30.50	20.40	3.90	29.40	7.45	14.4	5.53	13.3	1.46	1.4
	10/31/75	0700	2920	480	81.6	30.10	19.70	5.18	29.80	8.06	15.0	5.50	17.4	1.49	-3.5
	10/31/75	1100	2920	500	81.0	30.40	17.70	6.58	28.70	7.71	15.3	5.57	22.9	1.49	1.6
	10/31/75	1500	3000	520	80.8	30.20	18.90	7.58	31.20	5.73	14.9	5.38	24.3	1.33	3.5
	10/31/75	1500	2880	520	80.0	29.50	20.80	5.70	31.70	6.37	14.9	5.55	18.0	1.37	-2.6
	10/31/75	2300	3090	540	80.6	29.70	13.10	8.73	25.10	10.44	15.1	5.33	34.8	1.76	-4.9
	11/01/75	0300	3920	860	75.7	29.70	17.00	7.55	28.80	9.43	15.5	5.34	26.2	1.60	-8.4
	11/01/75	0700	3760	760	77.6	29.40	21.20	5.50	32.00	7.24	15.0	5.47	17.2	1.41	-7.6
	11/01/75	1100	3040	440	84.0	29.90	19.80	6.85	31.60	7.16	15.2	5.36	21.7	1.41	-4.5
	11/01/75	1500	2840	420	83.6	29.60	22.50	3.38	31.50	6.18	15.3	5.99	10.7	1.36	-1.1
	11/01/75	1900	2480	380	83.0	29.10	18.40	5.10	28.10	8.46	14.5	5.61	18.2	1.55	-4.7
	11/03/75	0300	2520	400	82.4	28.90	14.00	7.10	24.60	10.16	16.2	6.17	28.9	1.75	-4.4
	11/03/75	0700	3240	600	79.5	29.60	19.70	5.38	30.00	5.14	14.6	5.83	17.9	1.31	6.9
	11/03/75	1100	3000	600	77.9	29.50	20.00	5.10	30.10	5.29	14.7	5.84	17.0	1.32	5.7
	11/03/75	1500	3200	600	79.2	29.40	19.90	7.43	32.30	6.00	14.3	5.17	23.0	1.34	-3.0
	11/03/75	1900	2800	480	81.0	29.40	20.90	5.48	31.60	6.83	14.7	5.50	17.3	1.39	-4.9
	11/03/75	2300	2720	480	80.5	30.10	19.50	7.03	31.40	7.75	14.8	5.11	22.4	1.45	-5.9
	11/04/75	0300	2440	300	86.4	30.30	19.40	5.95	30.20	8.19	14.7	5.23	19.7	1.49	-4.3
	11/04/75	0700	2680	440	81.8	29.70	19.40	4.95	29.20	7.52	14.1	5.38	17.0	1.47	-1.1
	11/04/75	1100	2800	420	83.4	29.70	17.20	6.00	27.50	7.74	15.0	5.74	21.8	1.51	1.9
	11/04/75	1500	2720	480	80.5	29.20	19.30	5.48	29.60	6.08	14.4	5.68	18.5	1.37	2.5
	11/04/75	1900	2720	480	80.5	29.20	20.10	4.08	29.20	6.47	14.6	5.90	14.0	1.40	1.7
	11/04/75	2300	2980	600	77.7	28.80	15.90	7.73	27.60	9.39	14.7	5.33	28.0	1.62	-8.7
	11/05/75	0300	3400	600	73.9	28.80	17.40	7.05	28.80	8.74	14.3	5.22	24.5	1.55	-8.7
	11/05/75	0700	3720	940	72.0	29.00	21.50	5.43	32.30	6.23	15.2	5.73	16.8	1.35	-5.4

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
562-2B	11/05/75	1100	3360	740	75.6	29.20	19.10	7.23	31.10	6.65	14.6	5.40	23.2	1.40	-4.5
	11/05/75	1500	3440	720	76.8	29.60	23.50	5.23	34.60	5.30	15.1	5.52	15.1	1.28	-4.7
	11/05/75	1900	3280	700	76.4	29.40	22.30	5.73	33.60	7.38	15.0	5.22	17.1	1.40	-12.0
	11/05/75	2300	3600	900	72.3	29.50	22.30	8.13	36.00	4.74	15.2	5.18	22.6	1.24	-6.0
	11/06/75	0300	3840	1000	71.1	27.70	23.90	3.93	33.80	5.96	15.3	6.05	11.6	1.32	-12.9
	11/06/75	0700	3840	1020	70.6	29.30	23.20	4.50	33.50	6.73	15.1	5.58	13.4	1.37	-9.4
563-2A	11/06/75	1530	3640	890	72.9	29.50	24.30	3.03	33.40	6.79	14.9	5.60	9.1	1.37	-8.6
	11/06/75	1900	3080	590	79.1	29.40	20.50	4.18	29.80	9.35	15.0	5.54	14.0	1.57	-11.5
	11/06/75	2300	2880	450	82.7	30.70	21.80	4.25	31.50	9.30	14.5	4.99	13.5	1.54	-10.5
	11/07/75	0300	3200	520	82.0	31.70	22.40	3.40	31.40	9.25	14.8	5.05	10.8	1.54	-6.6
	11/07/75	0700	3160	460	83.9	33.60	21.50	4.03	30.90	10.18	14.8	4.62	13.0	1.60	-3.0
	11/07/75	1100	3080	340	87.6	37.60	19.30	2.18	26.30	12.00	15.5	4.63	8.3	1.83	10.3
	11/07/75	1500	2960	300	88.8	36.50	17.80	5.15	27.40	13.15	15.0	4.03	18.8	1.87	1.5
	11/07/75	1900	2840	260	89.9	38.60	19.20	2.00	26.00	14.84	15.0	3.98	7.7	2.04	3.8
	11/08/75	0300	3040	360	86.9	36.80	21.70	8.38	35.50	12.46	14.1	2.73	23.6	1.64	-10.7
	11/08/75	0700	3040	360	86.9	34.80	19.10	4.23	28.10	9.35	15.2	4.98	15.0	1.61	9.2
	11/08/75	1100	3000	380	86.0	36.30	18.60	2.65	25.90	12.76	15.1	4.60	10.2	1.90	5.2
	11/08/75	1500	2840	380	85.2	35.10	21.10	3.13	29.50	9.09	15.1	4.89	10.6	1.56	8.1
	11/08/75	1900	3120	540	80.8	34.10	19.00	3.25	27.00	10.44	15.1	5.11	12.1	1.70	5.5
	11/08/75	2300	2880	480	81.6	35.30	21.40	3.25	30.00	9.72	15.2	4.74	10.8	1.59	5.4
	11/09/75	0300	2880	460	82.3	33.60	20.20	5.85	31.10	7.95	15.5	4.91	18.8	1.47	5.0
	11/09/75	0700	3000	460	83.0	32.90	21.60	1.50	28.50	8.09	14.9	5.59	5.3	1.52	8.0
	11/09/75	1100	3040	540	80.3	32.60	20.70	2.53	28.40	7.70	15.1	5.67	8.9	1.49	8.9
	11/09/75	1500	3080	600	78.4	34.80	23.90	3.03	32.90	8.24	14.8	4.65	9.2	1.46	3.6
	11/09/75	1900	3000	400	85.3	35.10	20.40	1.90	27.40	12.02	15.2	4.86	6.9	1.89	1.7
	11/09/75	2300	2960	360	86.6	35.90	23.00	3.25	32.00	8.45	14.9	4.54	10.2	1.48	7.6
	11/10/75	0300	3160	380	86.7	37.20	22.20	2.55	30.30	10.10	15.3	4.50	8.4	1.61	8.3
	11/10/75	0700	3120	300	89.4	34.90	19.80	3.75	28.50	13.11	15.8	4.56	13.2	1.84	-5.1
	11/10/75	1100	3000	280	89.7	35.30	22.40	1.50	29.50	12.56	13.3	4.02	5.1	1.77	-3.9
	11/10/75	1500	3040	360	86.9	32.30	22.30	1.73	29.60	11.63	14.8	4.99	5.8	1.71	-10.1
	11/10/75	1900	3520	500	84.3	33.90	19.40	1.75	26.00	13.21	15.4	5.10	6.7	1.92	-3.4
	11/10/75	2300	3600	540	83.4	33.90	22.80	2.50	31.00	11.13	15.4	4.78	8.1	1.65	-5.9
	11/11/75	0300	3800	560	83.7	32.60	23.30	1.88	31.00	1.07	15.2	5.07	6.1	1.06	29.2
	11/11/75	0700	3920	600	83.1	32.50	19.40	3.35	27.60	11.76	15.0	5.02	12.2	1.78	-5.6
	11/11/75	1100	3880	580	83.5	33.00	22.00	1.60	29.10	8.91	15.2	5.50	5.5	1.56	3.8
	11/11/75	1500	3600	480	85.3	35.70	20.90	0.58	26.70	13.10	15.1	4.78	2.2	1.89	0.9
	11/11/75	1900	3560	540	83.2	32.50	21.00	0.45	26.70	12.47	15.2	5.43	1.7	1.85	-6.4
	11/11/75	2300	3720	620	81.6	31.60	23.40	1.65	30.90	12.06	15.3	5.08	5.4	1.71	-17.1
	11/12/75	0300	4000	660	81.7	31.30	27.10	1.33	35.20	8.30	15.4	4.99	3.8	1.43	-12.6
	11/12/75	0700	3840	740	78.7	30.70	19.50	5.03	29.40	11.76	14.9	4.87	17.1	1.73	-15.9
	11/12/75	1100	3440	540	82.6	29.80	18.40	4.10	27.10	12.43	14.6	5.18	15.1	1.83	-16.9
	11/12/75	1500	3120	340	88.0	30.80	20.90	1.38	27.50	11.97	15.3	5.61	5.0	1.79	-12.1
	11/12/75	1900	3080	320	88.5	31.20	16.00	4.50	24.50	14.96	15.0	4.95	18.4	2.11	-16.1
	11/12/75	2300	3080	340	87.8	33.50	20.40	2.80	28.30	10.83	14.7	4.89	9.9	1.70	-0.4
	11/13/75	0300	2840	240	90.7	33.80	18.50	3.68	26.80	9.65	15.1	5.22	13.7	1.66	8.1
	11/13/75	0700	2720	240	90.3	29.70	17.50	6.43	28.30	12.43	15.4	5.11	22.7	1.80	-20.1
	11/13/75	1100	3000	280	89.7	29.50	16.60	9.55	30.30	10.65	14.4	4.51	31.5	1.64	-17.9
	11/13/75	1600	3240	300	89.8	33.30	20.40	1.80	27.30	16.24	15.2	5.03	6.6	2.08	-19.6
	11/13/75	1900	3280	260	91.3	35.60	18.30	3.83	26.70	14.11	14.7	4.13	14.3	1.96	-3.0
	11/13/75	2300	3160	280	90.2	34.10	20.90	2.88	29.00	10.66	15.6	5.04	9.9	1.67	0.6
	11/14/75	0300	3240	320	89.1	35.30	20.90	4.08	30.20	9.77	15.4	4.68	13.5	1.59	4.8

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
563-2A	11/14/75	0700	3300	320	89.3	35.00	17.40	5.25	27.00	12.09	15.7	4.63	19.5	1.81	1.9
564-2A	11/14/75	1900	3720	1060	68.4	27.80	21.90	8.43	35.80	3.25	13.8	5.14	23.5	1.17	-5.1
	11/14/75	2300	3720	1480	55.9										
	11/15/75	0300	3360	1280	57.8	24.50	23.70	4.68	34.30	2.08	14.3	6.51	13.6	1.11	-8.9
	11/15/75	0700	3240	1200	58.9	23.60	22.90	3.18	31.80	2.11	14.3	7.04	10.0	1.12	-5.8
	11/15/75	1100	3200	1160	59.8	23.80	23.80	2.65	32.40	0.87	13.0	6.57	8.2	1.05	0.0
	11/15/75	1500	3000	960	64.5	25.30	25.60	3.11	35.10	1.04	12.2	5.67	8.8	1.05	-2.4
	11/15/75	1900	2940	1080	59.3	25.00	24.60	4.25	35.00	0.63	12.6	5.84	12.2	1.03	-1.3
	11/15/75	2300	2920	1160	56.0	25.00	24.60	4.95	35.70	0.77	12.8	5.80	13.9	1.04	-4.0
	11/16/75	0300	2520	1020	55.1	24.00	21.50	6.73	33.60	1.43	12.8	5.83	20.0	1.08	-5.7
	11/16/75	0700	2960	1300	51.3	23.10	20.30	6.03	31.40	1.31	13.2	6.41	19.2	1.08	-2.4
	11/16/75	1100	3360	1400	53.8	23.40	21.60	4.50	31.50	1.29	13.6	6.71	14.3	1.07	-1.3
	11/16/75	1500	3440	1560	49.7	23.90	22.80	5.00	33.50	0.65	14.6	6.97	14.9	1.04	-1.6
	11/16/75	1900	3600	1600	50.7	24.00	20.70	7.73	33.60	1.07	14.6	6.63	23.0	1.06	-3.7
	11/16/75	2300	3600	1560	52.0	22.90	20.40	5.30	30.80	1.43	14.3	7.14	17.2	1.08	-2.2
	11/17/75	0300	3420	1440	53.3										
	11/17/75	0700	3280	1200	59.4	23.70	19.40	6.55	30.80	1.49	15.0	7.23	21.3	1.09	1.0
	11/17/75	1100	3560	1670	48.0	23.70	23.50	3.43	32.80	0.83	14.5	7.16	10.5	1.05	-1.4
	11/17/75	1500	3160	1480	48.1	22.30	20.00	5.00	30.00	0.50	14.3	7.48	16.7	1.03	2.9
	11/17/75	1900	3080	1500	46.0	21.70	20.20	4.25	29.50	0.33	13.7	7.40	14.4	1.02	2.8
	11/17/75	2300	2920	1180	55.2	23.00	19.50	6.03	30.40	1.82	15.1	7.42	19.8	1.11	-2.7
	11/18/75	0300	2800	940	62.8	23.30	20.40	5.90	31.40	1.82	14.1	6.81	18.8	1.11	-4.4
	11/18/75	0700	2960	940	64.8	24.20	23.00	3.85	32.60	1.35	13.4	6.53	11.8	1.08	-1.5
	11/18/75	1100	2920	1220	53.7	23.80	22.30	5.13	33.00	0.88	12.2	5.88	15.5	1.05	-1.8
	11/18/75	1500	2800	1340	46.9	23.40	20.80	6.40	32.40	0.66	11.3	5.46	19.8	1.04	-0.6
	11/18/75	1900	3120	1260	55.2	23.70	21.40	5.15	31.90	0.99	12.1	5.89	16.2	1.06	0.4
	11/18/75	2300	3600	1300	60.0	23.70	19.80	6.55	31.30	1.79	13.5	6.40	20.9	1.10	-2.1
	11/19/75	0300	3440	1280	58.7	23.30	19.90	6.53	31.40	1.58	14.1	6.74	20.8	1.09	-3.0
	11/19/75	0700	4040	1500	58.8	24.00	22.10	4.08	31.70	1.38	15.8	7.62	12.9	1.11	-3.0
565-2A	11/21/75	1900	3900	1380	60.8	22.60	19.50	5.83	30.20	1.60	8.5	4.23	19.3	1.10	-2.6
	11/21/75	2300	4060	1260	65.6	24.10	23.00	3.45	32.20	1.59	10.9	5.33	10.7	1.09	-2.0
	11/22/75	0300	3960	1460	59.1	23.90	23.80	3.35	33.10	0.97	13.5	6.64	10.1	1.05	-2.2
	11/22/75	0700	3920	1600	54.7	23.90	25.00	1.86	33.10	0.88	14.5	7.28	5.6	1.05	-1.7
	11/22/75	1100	4160	1580	57.9	25.70	24.30	2.13	32.50	1.16	15.1	7.32	6.6	1.06	5.7
	11/22/75	1500	3800	1540	55.1	24.20	24.90	3.38	34.50	0.84	14.8	7.08	9.8	1.04	-4.3
	11/22/75	1900	3680	1460	56.0	22.20	21.30	4.18	30.80	1.07	15.5	8.04	13.6	1.06	-3.3
	11/22/75	2300	3440	1240	63.0	24.00	24.80	2.60	33.60	0.81	15.4	7.64	7.8	1.04	-2.4
	11/23/75	0300	3440	1310	57.8	23.20	23.20	3.20	32.20	0.87	14.4	7.31	10.0	1.05	-2.0
	11/23/75	0700	3280	1290	56.7	23.30	23.90	2.43	32.30	0.88	13.6	6.92	7.5	1.05	-1.9
	11/23/75	1100	3360	1220	59.7	23.10	21.50	5.43	32.30	1.49	13.2	6.40	16.8	1.08	-6.2
	11/23/75	1500	3480	1300	58.6	23.60	23.50	3.33	32.70	0.61	14.4	7.19	10.2	1.03	-0.4
	11/23/75	1900	3800	1540	55.1	23.50	22.60	4.65	32.90	0.77	14.8	7.26	14.1	1.04	-2.2
	11/23/75	2300	4150	1720	54.0	22.50	21.70	4.08	31.20	0.94	15.1	7.76	13.1	1.05	-2.5
	11/24/75	0300	4280	1850	52.1	22.40	21.70	3.58	30.70	0.63	15.3	8.00	11.7	1.05	-0.7
	11/24/75	0700	4240	1880	50.8	22.10	20.20	5.35	30.60	0.88	15.3	7.84	17.5	1.05	-2.1
	11/24/75	1100	4320	2000	48.7	22.40	22.90	1.88	30.50	0.91	14.8	7.91	6.2	1.05	-0.6
	11/24/75	1500	4300	1800	53.6	22.60	22.00	4.10	31.60	0.77	14.8	7.54	13.0	1.04	-2.3
	11/24/75	1900	3760	1500	55.8	23.00	21.80	5.55	32.80	0.72	15.0	7.30	16.9	1.04	-3.9
	11/24/75	2300	3480	1260	59.9	22.20	21.90	3.43	30.80	1.16	14.4	7.52	11.1	1.07	-3.8
	11/25/75	0300	3440	1320	57.5	21.70	21.30	3.18	29.60	1.10	13.8	7.41	10.7	1.07	-2.7
	11/25/75	0700	3120	1160	58.8	22.00	22.70	1.23	29.60	0.94	13.8	7.56	4.2	1.06	0.3

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
565-2A	11/25/75	1100	2840	960	62.5	21.70	21.00	2.45	28.70	1.60	14.2	7.70	8.6	1.10	-2.0
	11/25/75	1500	2760	980	60.6	22.40	17.60	8.20	30.20	0.99	14.2	6.94	27.2	1.06	-0.1
	11/25/75	1900	3000	1060	60.1	22.00	19.30	5.26	29.40	1.96	13.8	7.10	18.0	1.12	-5.1
	11/25/75	2300	2960	1080	59.6	21.80	20.50	3.48	29.10	0.83	14.2	7.69	12.0	1.05	1.6
	11/26/75	0300	3000	1200	55.7	21.50	21.30	2.08	28.70	0.66	14.0	7.81	7.2	1.04	2.6
566-2A	11/26/75	0700	3000	1140	57.9	22.00	22.20	1.65	29.60	0.66	14.0	7.68	6.3	1.04	1.9
	11/26/75	1500	2960	660	75.3	24.30	22.40	3.00	31.00	1.87	13.8	6.86	9.7	1.11	0.8
	11/26/75	1900	2920	340	87.1	23.90	21.60	2.20	29.20	1.98	15.0	7.74	7.5	1.12	3.9
	11/26/75	2300	2920	240	90.9	30.90	19.90	5.33	30.20	8.86	15.2	5.25	17.6	1.53	-5.0
	11/27/75	0300	2960	260	90.3	31.80	22.60	1.85	30.10	9.24	14.7	5.31	6.2	1.56	-3.3
	11/27/75	0700	2800	260	89.7	32.80	18.80	6.70	30.20	9.76	15.0	4.62	22.2	1.59	-2.5
	11/27/75	1100	2840	360	86.0	30.10	21.20	6.80	33.30	6.28	14.5	5.05	20.4	1.34	-4.1
	11/27/75	1500	2520	320	86.0	28.60	24.70	3.13	34.00	5.12	14.5	5.76	9.2	1.27	-6.1
	11/27/75	1900	2680	420	82.7	28.30	22.10	4.98	32.60	5.94	14.8	5.74	15.3	1.33	-7.4
	11/27/75	2300	3200	580	79.9	28.40	21.30	5.08	31.70	6.82	15.3	5.88	16.0	1.39	-8.8
	11/28/75	0300	3640	700	78.7	28.40	24.70	3.23	34.10	5.50	14.9	5.87	9.5	1.29	-8.8
	11/28/75	0700	3320	580	80.7	28.70	21.00	7.35	33.60	5.56	15.0	5.45	21.9	1.30	-6.7
	11/28/75	1100	2880	440	83.1	29.30	21.80	6.75	34.00	4.55	15.0	5.52	19.9	1.24	-1.1
	11/28/75	1500	2660	400	83.4	28.80	23.20	5.30	34.30	4.69	14.6	5.57	15.5	1.25	-4.2
	11/28/75	1900	2560	400	82.7	27.50	24.10	4.28	34.40	3.58	14.6	5.98	12.4	1.19	-4.2
	11/28/75	2300	2600	480	79.6	26.90	25.20	5.41	36.90	3.08	14.8	5.90	14.6	1.15	-10.7
	11/29/75	0300	2680	500	79.3	27.20	25.10	5.63	37.00	3.03	14.4	5.64	15.2	1.15	-9.5
	11/29/75	0700	2600	460	80.4	27.10	22.00	9.00	36.50	2.68	14.7	5.55	24.7	1.13	-6.9
	11/29/75	1100	2600	340	85.5	28.40	21.30	8.68	35.30	3.30	14.8	5.42	24.6	1.17	-1.9
	11/29/75	1500	2600	330	86.0	28.70	24.10	5.18	35.30	4.19	15.1	5.74	14.7	1.22	-4.8
	11/29/75	1900	2590	330	85.9	27.90	19.10	7.73	31.60	6.11	14.7	5.55	24.5	1.35	-7.2
	11/29/75	2300	3160	620	78.3	27.00	24.70	3.23	34.10	3.85	14.6	6.20	9.5	1.21	-6.6
	11/30/75	0300	3600	1020	68.6	26.50	25.30	3.38	35.00	3.03	15.1	6.47	9.7	1.16	-7.1
	11/30/75	0700	3880	1060	69.7	26.80	25.30	4.78	36.40	1.79	14.8	6.20	13.1	1.09	-3.6
	11/30/75	1100	3800	880	74.3	26.20	25.50	0.63	32.50	2.31	15.0	7.20	1.9	1.13	1.9
	11/30/75	1500	3840	920	73.5	25.40	25.30	1.68	33.30	2.92	15.5	7.25	5.0	1.16	-6.5
	11/30/75	1900	3680	700	78.9	26.00	25.80	2.46	34.70	3.14	15.1	6.68	7.1	1.16	-8.9
	11/30/75	2300	3200	440	84.8	26.90	24.40	3.20	33.70	4.51	14.1	5.94	9.5	1.24	-9.1
	12/01/75	0300	3920	720	79.7	27.80	24.50	3.88	34.50	4.62	15.3	6.15	11.2	1.24	-8.1
	12/01/75	0700													
	12/01/75	1100	3600	600	81.6	27.10	24.50	2.98	33.60	4.51	14.9	6.26	8.9	1.24	-8.1
	12/01/75	1500	3440	600	80.7	26.60	26.20	1.16	33.90	3.27	15.5	7.08	3.4	1.18	-4.9
	12/01/75	1900	3480	540	82.8	27.30	24.30	2.63	33.00	3.81	14.6	6.33	8.0	1.21	-2.5
	12/01/75	2300	3560	500	84.5	28.10	24.80	1.60	32.60	4.68	15.6	6.67	4.9	1.26	-2.5
	12/02/75	0300	3200	480	83.4	29.20	23.80	2.35	32.10	5.23	15.5	6.33	7.3	1.30	0.2
	12/02/75	0700	3120	340	88.0	30.30	23.90	2.63	32.50	5.67	15.2	5.92	8.1	1.32	1.0
	12/02/75	1100	3480	540	82.8	29.10	24.80	4.20	35.20	4.62	15.3	5.80	11.9	1.24	-5.0
	12/02/75	1500	3120	500	82.3	28.20	26.50	3.48	36.60	1.66	15.4	6.42	9.5	1.08	1.6
	12/02/75	1900	3200	670	76.8	27.40	22.60	5.45	33.70	4.67	15.2	6.03	16.2	1.25	-7.9
	12/02/75	2300	3120	520	81.6	27.30	25.30	4.18	35.80	3.50	15.5	6.31	11.7	1.18	-8.2
	12/03/75	0300	2960	420	84.3	27.40	25.20	1.41	32.90	3.68	15.7	6.99	4.3	1.20	-1.2
	12/03/75	0700	2800	400	84.2	27.30	21.30	4.08	30.70	4.95	15.5	6.45	13.3	1.29	-1.9
	12/03/75	1100	2880	340	86.9	28.40	23.00	3.95	32.70	5.83	15.7	6.25	12.1	1.32	-6.8
567-2A	12/03/75	1500	2920	400	86.8	27.90	24.80	2.20	33.20	4.58	15.6	6.62	6.6	1.25	-4.3
	12/03/75	1900	3060	440	85.1	27.40	19.70	5.28	29.90	6.46	14.9	6.18	17.7	1.39	-6.5
	12/03/75	2300	3140	540	81.0	27.70	20.10	7.28	32.40	4.41	15.1	5.94	22.5	1.25	-2.2

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
567-2A	12/04/75	0300	3280	540	81.8	27.60	20.80	6.30	32.30	5.28	14.9	5.89	19.5	1.30	-6.4
	12/04/75	0700	3720	740	78.0	27.90	19.00	7.15	30.90	6.33	15.3	5.89	23.2	1.37	-6.5
	12/04/75	1100	3520	560	82.4	29.00	23.90	3.03	32.90	5.94	15.1	5.96	9.2	1.33	-5.6
	12/04/75	1500	3240	500	82.9	28.90	22.20	3.25	31.00	6.82	14.9	5.88	10.5	1.40	-5.2
	12/04/75	1900	3360	560	81.6	28.90	25.30	1.38	33.00	5.80	15.1	6.14	4.2	1.32	-5.6
	12/04/75	2300	3080	420	84.9	28.80	22.20	3.35	31.10	6.59	14.7	5.87	10.8	1.39	-4.8
	12/05/75	0300	3040	380	86.2	28.80	22.80	3.10	31.60	5.92	15.0	6.05	9.8	1.34	-3.1
	12/05/75	0700	3120	440	84.4	29.90	23.10	3.23	32.10	7.15	15.2	5.71	10.1	1.41	-5.7
	12/05/75	1100	2920	320	87.9	30.80	21.70	4.06	31.20	8.80	15.1	5.28	13.1	1.51	-7.4
	12/05/75	1500	2560	260	88.8	31.00	22.90	2.98	31.60	8.80	14.8	5.23	9.4	1.51	-7.6
	12/05/75	1900	2280	240	88.4	30.40	22.20	3.05	30.80	8.47	14.3	5.30	9.9	1.50	-6.5
	12/05/75	2300	3000	440	83.8	29.70	20.80	4.50	30.50	9.21	14.6	5.25	14.8	1.55	-11.4
	12/06/75	0300	3080	420	84.9	29.80	23.00	3.75	32.50	6.29	15.8	6.02	11.6	1.35	-3.3
	12/06/75	0700	3000	480	82.3	30.10	16.90	6.28	27.40	9.57	15.5	5.58	22.9	1.64	-4.3
	12/06/75	1100	2840	380	85.2	29.60	22.00	3.30	30.80	7.92	15.0	5.69	10.7	1.47	-7.0
	12/06/75	1500	3000	380	86.0	29.90	22.30	3.33	31.20	7.87	15.1	5.67	10.7	1.46	-6.6
	12/06/75	1900	2920	440	83.3	30.20	20.70	4.93	30.80	8.25	15.2	5.44	16.0	1.49	-6.2
	12/06/75	2300	3100	390	86.1	29.90	22.20	3.85	31.60	6.22	15.1	5.80	12.2	1.36	-8.5
	12/07/75	0300	3200	440	84.8	30.20	21.90	4.33	31.70	7.80	15.4	5.59	13.7	1.45	-6.4
	12/07/75	0700	3080	360	87.1	30.60	20.80	4.30	30.30	8.69	15.8	5.64	14.2	1.52	-5.5
	12/07/75	1100	2960	380	85.8	30.70	21.10	3.63	30.00	8.97	15.5	5.63	12.1	1.54	-5.7
	12/07/75	1500	3560	480	85.1	30.70	22.30	3.63	31.50	8.75	15.3	5.40	11.5	1.51	-8.2
	12/07/75	1900	3680	560	83.2	30.80	23.00	2.85	31.60	8.20	15.6	5.65	9.0	1.47	-5.8
	12/07/75	2300	3800	560	83.7	30.90	21.10	4.43	30.80	9.16	15.5	5.38	14.4	1.54	-7.6
	12/08/75	0300	3720	580	82.7	30.80	21.20	5.10	31.60	8.73	15.7	5.36	16.2	1.50	-8.0
	12/08/75	0700	3720	660	80.4	30.50	21.80	4.05	31.30	8.47	15.5	5.50	13.0	1.49	-7.3
	12/08/75	1100	3960	640	82.1	30.50	21.80	5.25	32.50	8.20	15.9	5.45	16.2	1.46	-8.9
	12/08/75	1500	4200	800	78.9	29.80	24.90	2.68	33.80	6.01	15.4	5.88	7.9	1.32	-5.1
	12/08/75	1900	4020	750	79.1	29.90	28.00	1.21	36.20	4.64	15.7	6.11	3.3	1.23	-4.6
	12/08/75	2300	3960	640	82.1	30.70	24.00	4.80	34.80	7.84	15.0	4.97	13.8	1.41	-11.9
	12/09/75	0300	3160	440	84.6	30.60	27.90	1.83	36.70	5.16	14.7	5.41	5.0	1.26	-5.5
	12/09/75	0700	3320	520	82.7	30.80	21.10	5.53	31.90	9.38	15.0	4.95	17.3	1.53	-11.4
568-2A	12/09/75	1600	2840	490	81.3	28.50	26.90	3.68	37.30	3.80	14.2		9.9	1.19	-8.7
	12/09/75	1900	2800	560	77.9	27.60	27.60	4.11	38.60	2.64	14.0		10.6	1.12	-10.2
	12/09/75	2300	3320	940	68.6	27.20	27.20	4.81	38.80	2.15	14.5		12.4	1.10	-10.0
	12/10/75	0300	3440	1060	65.8	26.50	27.80	3.06	37.80	1.82	15.7		8.1	1.09	-8.7
	12/10/75	0700	3640	1040	68.3	25.50	24.40	4.80	35.30	1.49			13.6	1.08	-4.4
	12/10/75	1100	3400	920	70.0	25.10	23.40	5.85	35.10	1.72	14.7		16.7	1.09	-6.7
	12/10/75	1500	3360	1000	67.0	27.50	27.60	7.71	42.20	0.88	14.8		18.3	1.04	-11.6
	12/10/75	1900	3120	1060	62.3	29.50	26.80	5.51	39.00	0.99	14.9		14.1	1.05	3.1
	12/10/75	2300	3200	960	66.9	26.60	26.30	6.73	39.60	0.94	14.8		17.0	1.04	-8.8
	12/11/75	0300	3120	940	66.6	25.00	24.50	6.18	36.80	1.16	15.1		16.8	1.06	-9.0
	12/11/75	0700	3800	1360	60.3	22.96	22.81	7.81	36.32	0.73	15.8		21.5	1.04	-14.9
	12/11/75	1100	3600	1200	63.1	22.50	21.40	7.75	34.50	0.59	15.7		22.5	1.03	-10.7
	12/11/75	1500	3400	1040	66.1	26.90	25.70	7.48	39.60	0.72	15.2	5.89	18.9	1.03	-6.5
	12/11/75	1501	3360	1050	65.4	24.90	25.60	2.51	34.50	0.72	15.2	7.29	7.3	1.04	-8.7
	12/11/75	1900	3360	1040	65.7	27.70	25.80	6.96	39.20	1.05	14.5	5.55	17.7	1.05	-4.0
	12/11/75	2300	3200	900	68.8	23.20	24.40	3.30	33.80	1.49	14.2	6.94	9.8	1.08	-10.2
	12/12/75	0300	2800	840	66.9	24.60	23.60	5.60	35.10	1.54	14.0	6.30	16.0	1.08	-7.9
	12/12/75	0700													
	12/12/75	0701	2660	835	65.2	24.70	25.10	2.83	34.20	1.39			8.3	1.07	-4.2

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
568-2A	12/12/75	0702	2640	830	65.2	23.50	25.00	7.36	38.60	1.39	14.7	6.22	19.1	1.07	-22.6
	12/12/75	1100	3200	1000	65.4	20.80	22.30	5.53	33.40	0.83	14.7	7.46	16.6	1.05	-17.6
	12/12/75	1500	3160	880	69.1	24.70	23.30	11.88	41.00	1.69	15.9	5.81	29.0	1.05	-21.9
	12/12/75	1900	3520	1240	60.9	25.40	22.10	11.78	39.40	0.90	15.1	5.61	29.9	1.04	-13.2
	12/12/75	2300	3480	1360	56.7	24.20	22.20	3.95	31.70	1.38	15.2	7.41	12.5	1.09	1.0
	12/12/75	2301	3500	1370	56.6	23.30	22.40	4.30	32.30	1.38	15.2	7.46	13.3	1.08	-4.7
	12/13/75	0300	3560	1380	57.0	24.10	23.20	3.80	32.80	1.49	15.1	7.31	11.6	1.08	-3.2
	12/13/75	0700	3680	1500	54.8	21.50	21.30	7.88	34.50	1.57	15.2	7.12	22.8	1.08	-21.7
	12/13/75	1100	3400	1240	59.6	24.40	24.30	9.63	40.00	1.00	14.8	5.81	24.1	1.05	-20.1
	12/13/75	1500													
	12/13/75	1502	3200	1100	61.9	24.90	19.10	15.23	39.10	0.67	15.0	5.30	38.9	1.03	-13.4
	12/13/75	1900	3280	1300	56.1	24.60	23.30	10.78	39.90	0.63	15.1	5.82	27.0	1.03	-16.9
	12/13/75	2300	3200	1140	60.5	23.80	23.10	4.73	33.60	1.32	14.7	7.01	14.1	1.07	-6.0
	12/14/75	0300	3090	1060	61.8	23.50	22.20	5.45	33.20	1.32	14.5	6.90	16.4	1.07	-6.1
	12/14/75	0700	3480	1380	56.0	21.50	21.60	4.30	31.30	1.24	15.6	8.07	13.8	1.07	-9.3
	12/14/75	1100	3320	1260	57.9	24.80	25.50	8.63	40.70	0.92	15.5	6.00	21.7	1.04	-19.7
	12/14/75	1500	3080	1100	60.4	23.10	24.10	6.08	36.20	1.24	15.3	6.93	16.8	1.06	-16.6
	12/14/75	1902	2720	900	63.3	22.00	25.80	10.16	42.40	1.83	14.7	5.71	24.0	1.08	-45.6
	12/14/75	2300	2840	900	64.9	25.00	24.90	5.68	36.80	1.38	15.0	6.51	15.4	1.07	-10.1
	12/14/75	2301	2840	910	64.5	24.60	25.10	4.43	35.80	1.38	14.9	6.79	12.4	1.07	-9.1
	12/15/75	0300	2800	960	62.0	22.30	21.10	5.83	32.20	1.49	15.5	7.67	18.1	1.08	-9.7
	12/15/75	0700	3360	1140	62.4	24.00	21.00	7.65	33.90	0.96	15.7	7.13	22.6	1.05	-4.0
	12/15/75	1100	3360	1100	63.7	26.50	23.50	8.83	38.20	0.70			23.1	1.03	-4.3
	12/15/75	1500	3600	1240	61.9	24.60	24.00	4.40	34.40	0.61	14.3	6.72	12.8	1.03	-1.1
	12/15/75	1501	3600	1260	61.2	26.30	23.90	7.63	37.50	0.61			20.3	1.03	-2.8
	12/15/75	1900	3360	1200	60.4	24.00	21.10	7.23	33.60	0.43	15.9	7.40	21.5	1.02	-0.3
	12/15/75	2300	3240	1100	62.4	24.40	25.30	2.88	34.50	0.44	15.8	7.71	8.3	1.02	-1.3
	12/15/75	2301	3320	1210	59.6	26.90	25.30	5.98	37.60	0.44	15.8	6.58	15.9	1.02	0.0
	12/16/75	0300	3720	1320	60.7	24.70	24.90	3.48	34.60	1.10	15.6	7.35	10.1	1.06	-3.6
	12/16/75	0700	3720	1400	58.3	24.90	25.70	2.78	34.90	0.72	15.6	7.42	8.0	1.04	-1.9
	12/16/75	0701	3720	1400	58.3	25.00	27.40	0.76	35.00	0.53	15.6	7.67	2.2	1.03	-0.6
569-2A	12/16/75	1500				23.70	23.40	3.55	32.80	0.71	15.3	7.61	10.8	1.04	-0.8
	12/16/75	1501				23.10	23.20	6.50	35.50	0.71			18.3	1.04	-11.6
	12/16/75	1900	3520	1200	62.2	24.10	23.10	3.63	32.50	1.27	15.3	7.47	11.2	1.07	-1.2
	12/16/75	2300	3800	1500	56.2	24.20	22.90	4.58	33.20	1.44	14.3	6.77	13.8	1.08	-3.7
	12/16/75	2301	3800	1460	56.8	25.20	22.90	9.68	38.30	1.44	14.3	5.57	25.3	1.07	-13.7
	12/17/75	0300	3540	1000	68.7	22.90	19.30	5.38	29.50	2.28	14.6	7.30	18.2	1.14	-2.9
	12/17/75	0700	3720	1260	62.5	23.60	20.80	5.50	31.50	1.53	14.7	7.11	17.5	1.09	-1.8
	12/17/75	1100	3600	1000	69.2	24.40	23.40	3.35	32.60	1.46	15.5	7.56	10.3	1.08	-1.2
	12/17/75	1500	4000	1460	59.5	23.70	20.90	6.38	32.50	1.05	14.4	6.82	19.6	1.06	-1.7
	12/17/75	1501	4000	1480	59.0	28.20	20.90	8.28	34.40	1.05			24.1	1.06	9.8
	12/17/75	1900	3560	1160	63.9	23.50	21.10	5.03	31.40	0.99	14.6	7.23	16.0	1.06	1.0
	12/17/75	2300	3000	900	66.8										
	12/18/75	0300	2780	930	66.9	24.40	22.90	5.18	33.80	0.78	14.2		15.3	1.04	-1.1
	12/18/75	0700	2520	600	73.6	23.80	19.70	6.28	30.90	1.76	14.3		20.3	1.10	-0.4
	12/18/75	1102	2400	620	71.4	22.50	18.10	6.08	28.70	1.70	14.6		21.2	1.11	1.0
	12/18/75	1500	2240	540	73.3	24.20	18.00	5.60	28.10	1.11	15.4		19.9	1.07	12.8
	12/18/75	1900	2720	720	70.7	24.40	17.10	6.23	27.60	1.63	14.6		22.6	1.11	12.3
	12/18/75	2300	2640	620	74.0	23.50	19.10	5.33	29.20	1.79	14.3		18.2	1.11	3.3
	12/19/75	0300	2640	700	70.6	22.50	19.10	6.58	29.20	1.62	14.5	7.27	22.5	1.10	-0.1
	12/19/75	0700													

-SOLID ANALYSES AT SCRUBBER INLET-

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569-2B	12/19/75	1500	2960	900	66.3	23.20	21.10	3.73	30.10	1.06	15.2	7.85	12.4	1.06	3.3
	12/19/75	1900	2840	980	61.7	22.60	17.60	6.60	28.60	1.85	15.2	7.64	23.1	1.12	0.9
	12/19/75	2300	2880	960	63.1	23.30	21.80	2.75	30.00	1.64	14.7	7.61	9.2	1.10	0.8
	12/20/75	0300	2880	1100	57.7										
	12/20/75	0700	2880	960	63.1	23.80	22.90	2.58	31.20	0.65	14.9	7.67	8.3	1.04	4.7
	12/20/75	1100	2800	900	64.4	22.10	18.70	4.83	28.20	1.36	15.1	7.98	17.1	1.09	2.8
	12/20/75	1500	2920	1060	59.0	23.80	23.10	3.23	32.10	1.27	15.1	7.55	10.1	1.07	-1.3
	12/20/75	1501	2950	1080	59.4	25.20	23.00	9.15	37.90	1.27	15.1	6.03	24.2	1.06	-11.8
	12/20/75	1900	3240	1200	58.9	23.10	21.50	3.93	30.80	1.16	15.9	8.07	12.8	1.07	0.2
	12/20/75	2300	3200	1000	65.4	24.60	23.80	3.05	32.80	1.42	15.3	7.39	9.3	1.08	-0.8
	12/21/75	0300	3240	1120	61.7	24.70	24.00	3.30	33.30	1.35	15.4	7.37	9.9	1.07	-1.4
	12/21/75	0700	3240	1020	65.1	24.80	23.50	3.73	33.10	1.52	15.3	7.27	11.3	1.08	-1.3
	12/21/75	1100	3000	860	68.2	23.90	24.40	2.00	32.50	1.25	16.2	8.15	6.2	1.07	-1.9
	12/21/75	1500	3080	940	66.2	23.70	23.00	2.85	31.60	1.54	15.4	7.72	9.0	1.09	-1.7
	12/21/75	1501	3000	960	64.5	25.00	23.00	6.95	35.70	1.54	15.4	6.60	19.5	1.08	-7.9
	12/21/75	1900	3320	1140	61.9	23.90	20.40	5.00	30.50	1.43	15.5	7.65	16.4	1.09	3.0
	12/21/75	2300	3800	1240	63.8	25.40	24.00	3.60	33.60	1.35	16.1	7.52	10.7	1.07	0.6
	12/22/75	0300	3840	1500	56.7	25.40	24.90	3.08	34.20	1.60	15.7	7.31	9.0	1.09	-2.3
	12/22/75	0700	3800	1340	60.9	24.80	23.20	2.90	31.90	1.52	15.5	7.56	9.1	1.09	2.1
	12/22/75	1100	3520	1340	57.8	24.30	20.20	5.45	30.70	1.70	15.1	7.29	17.8	1.10	2.6
	12/22/75	1500	2440	820	62.7	24.20	22.20	3.95	31.70	0.94	14.5	7.15	12.5	1.05	3.3
	12/22/75	1501	2420	810	62.9	23.90	22.10	7.88	35.50	0.94	14.5	6.37	22.2	1.05	-9.1
	12/22/75	1900	2440	800	63.7	23.80	21.80	2.85	30.10	1.16	14.4	7.39	9.5	1.07	5.2
	12/22/75	2300	2640	820	65.6	24.00	20.60	4.85	30.60	1.13	14.8	7.33	15.9	1.07	4.7
	12/23/75	0300	2640	880	63.1	24.10	19.90	5.53	30.40	1.45	14.0	6.79	18.2	1.09	4.9
	12/23/75	0700	2920	900	65.8	24.10	19.60	5.70	30.20	1.61	14.7	7.15	18.9	1.10	3.7
	12/23/75	0701	2960	900	66.3	24.50	19.60	6.20	30.70	1.51	14.7	7.01	20.2	1.09	4.4
570-2A	12/23/75	1100	2800	780	69.1	24.60	18.60	6.75	30.00	2.05	14.7	6.90	22.5	1.12	4.0
	12/23/75	1500	2840	560	78.2	25.20	19.00	5.05	28.80	3.30	15.3	7.20	17.5	1.21	3.3
	12/23/75	1501	2860	550	78.7	28.30	18.90	8.98	32.60	3.52	15.3	5.82	27.5	1.20	3.5
	12/23/75	1900	2960	600	77.6	26.10	18.20	4.65	27.40	4.95	14.9	6.84	17.0	1.33	2.3
	12/23/75	2300	3360	920	69.7	25.30	21.10	4.23	30.60	3.74	15.3	7.03	13.8	1.22	-3.6
	12/24/75	0300	3600	1060	67.4	25.70	22.70	3.83	32.20	2.86	15.5	7.10	11.9	1.16	-1.9
	12/24/75	0700	3440	940	69.7	24.30	22.50	1.78	29.90	2.97	15.7	7.87	6.0	1.18	-1.6
	12/24/75	1100	3320	960	68.0	26.30	25.10	2.73	34.10	2.75	15.3	6.81	8.0	1.15	-4.1
	12/24/75	1500	3000	660	75.6	25.60	23.70	3.58	33.20	3.03	15.0	6.78	10.8	1.17	-5.9
	12/24/75	1501	2860	630	75.6	29.00	23.70	6.08	35.70	3.03	15.0	5.70	17.0	1.15	0.5
	12/24/75	1900	2600	600	74.4	26.10	22.20	5.55	33.30	3.36	15.0	6.44	16.7	1.18	-5.8
	12/24/75	2300	2600	640	72.7	25.30	21.40	4.95	31.70	3.26	14.4	6.49	15.6	1.19	-4.2
	12/25/75	0300	2480	540	75.9	26.10	23.20	4.60	33.60	2.79	13.2	5.78	13.7	1.15	-3.8
	12/25/75	0700	2480	500	77.7	24.70	22.50	2.78	30.90	2.79	13.8	6.66	9.0	1.16	-2.0
	12/25/75	1100	2600	580	75.3	26.00	24.30	3.73	34.10	2.71	14.1	6.27	10.9	1.14	-5.2
	12/25/75	1500	2560	580	74.9	26.20	23.90	4.43	34.30	3.19	18.3	7.84	12.9	1.17	-7.2
	12/25/75	1501	2560	570	75.3	28.20	23.90	9.63	39.50	3.19	18.3	6.13	24.4	1.15	-12.5
	12/25/75	1900	3080	700	74.8	26.20	21.60	5.25	32.50	4.24	16.0	6.82	16.2	1.24	-7.5
	12/25/75	2300	3520	980	69.1	26.00	22.40	3.70	31.70	4.31	15.3	6.78	11.7	1.25	-6.5
	12/26/75	0300	3280	820	72.3	26.20	24.20	2.55	32.80	4.02	14.7	6.55	7.8	1.22	-7.2
	12/26/75	0700	3200	840	70.9	26.40	21.70	5.38	32.50	4.11	14.0	5.95	16.6	1.23	-6.1
	12/26/75	1100	3200	840	70.9	26.00	23.40	2.75	32.00	3.69	14.9	6.75	8.6	1.21	-4.3
	12/26/75	1500	3320	860	70.6	26.90	24.20	3.45	33.70	3.73	14.7	6.31	10.3	1.20	-5.4
	12/26/75	1900	3200	840	70.9	26.10	21.80	3.85	31.10	4.91	15.1	6.63	12.4	1.29	-7.4

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
570-2A	12/26/75	2300	2760	680	72.7	25.90	22.30	3.73	31.60	2.75	14.6	6.70	11.8	1.16	1.0
	12/27/75	0300	2560	690	73.2	25.40	21.00	4.75	31.00	3.23	14.2	6.52	15.3	1.19	-1.7
	12/27/75	0700	2680	680	71.9	25.30	18.70	7.73	31.10	3.11	14.8	6.47	24.9	1.18	-1.8
	12/27/75	1100	2600	660	71.9	24.80	18.80	6.30	29.80	3.01	14.7	6.62	21.2	1.18	0.4
	12/27/75	1500	2320	560	73.3	25.20	22.10	2.68	30.50	2.46	14.6	7.07	9.4	1.15	2.8
	12/27/75	1900	2360	580	72.2	24.70	18.90	5.08	28.70	3.26	14.3	6.85	17.7	1.21	1.8
	12/27/75	2300	2600	720	69.3	23.80	16.40	4.40	27.40	3.07	13.3	6.70	16.1	1.20	2.9
	12/28/75	0300	2480	560	75.0	24.00	18.70	5.63	29.00	2.89	14.4	6.97	19.4	1.18	0.0
	12/28/75	0700	2680	640	73.5	23.60	19.90	4.73	29.60	2.89	14.8	7.36	16.0	1.18	-3.5
	12/28/75	1100	2760	840	66.3	23.30	18.90	4.76	28.40	2.71	14.8	7.38	16.8	1.17	-0.2
	12/28/75	1500	2960	820	69.3	24.30	22.40	3.30	31.30	1.90	15.1	7.40	10.6	1.11	-0.9
	12/28/75	1900	3140	880	68.9	24.50	21.90	3.63	31.20	2.67	15.0	7.15	12.3	1.16	-3.1
	12/28/75	2300	3480	1200	61.8	24.80	22.10	3.68	31.30	3.03	15.4	7.31	11.8	1.18	-4.0
	12/29/75	0300	3840	1340	61.3	24.90	22.70	3.13	31.50	1.82	15.4	7.48	9.9	1.11	2.1
	12/29/75	0700	3840	1300	62.5	23.80	22.30	1.93	29.80	2.14	15.2	7.83	6.5	1.13	0.8
571-2A	12/29/75	1100	3380	1040	65.9	23.60	22.50	1.96	30.10	1.96	14.5	7.47	6.6	1.12	0.1
	12/29/75	1500	2880	780	70.0	23.60	23.00	0.85	29.60	2.32	15.8	8.27	2.9	1.14	-0.4
	12/29/75	1900	2720	680	72.3	23.60	17.90	5.03	27.40	3.94	14.8	7.26	18.4	1.26	-2.6
	12/29/75	2300	2720	560	76.4	25.00	17.50	5.13	27.00	3.19	15.3	7.48	19.0	1.21	0.1
	12/30/75	0300	3160	760	73.4	25.40	19.20	3.10	27.10	3.69	15.4	7.59	11.5	1.25	6.8
	12/30/75	0700	3040	720	73.8	25.40	17.80	3.85	26.10	5.23	14.5	6.95	14.8	1.36	1.8
	12/30/75	0701	3040	700	74.5	25.80	18.00	4.00	26.50	5.39	14.5	6.77	15.1	1.37	1.4
	12/30/75	1100	2880	700	73.1	25.20	18.10	4.36	27.00	5.23	15.4	6.77	16.2	1.35	-1.5
	12/30/75	1500	2760	720	71.1	24.30	21.90	1.83	29.20	2.99	15.3	7.44	6.3	1.19	0.1
	12/30/75	1900	2700	700	71.3	23.10	18.20	3.85	26.60	3.56	15.6	8.84	14.5	1.24	-0.3
	12/30/75	2300	2700	700	71.3	23.50	19.00	3.95	27.70	2.68	15.6	7.98	14.3	1.18	2.9
	12/31/75	0300	2680	660	72.7	23.40	18.90	3.58	27.20	3.17	14.8	7.63	13.2	1.21	1.3
	12/31/75	0700	2720	660	73.1	24.20	20.90	0.68	26.80	3.80	15.9	8.35	2.5	1.26	2.4
	12/31/75	1100	2720	580	76.4	23.00	18.70	0.93	24.30	4.57	15.5	8.42	3.8	1.34	0.7
	12/31/75	1500	2360	510	76.1	23.90	16.70	4.43	25.30	4.59	14.6	7.33	17.5	1.33	1.4
	12/31/75	1902	2220	390	80.6	23.93	16.70	4.43	25.30	4.59	14.8	7.83	17.5	1.33	1.4
	12/31/75	2300	2120	370	80.7	24.60	17.10	3.93	25.30	4.62	14.9	7.40	15.5	1.33	4.0
	01/01/76	0300	2500	540	76.1	24.00	18.20	2.85	25.60	3.87	15.0	7.75	11.1	1.27	4.7
	01/01/76	0700	3160	760	73.4	24.70	17.60	5.45	26.70	4.46	14.2	6.77	20.4	1.30	1.3
	01/01/76	1100	2680	580	76.0	24.50	17.10	4.73	26.10	4.79	15.0	7.30	18.1	1.33	0.5
	01/01/76	1500	2480	480	78.6	24.80	20.90	2.48	28.60	3.39	14.1	6.97	8.7	1.22	1.8
	01/01/76	1900	2520	510	77.6	24.80	15.90	5.63	25.70	5.67	14.9	7.00	22.7	1.40	-1.7
	01/01/76	2300	2560	540	76.6	25.60	21.60	3.20	30.20	4.22	15.0	6.94	10.6	1.25	-3.6
	01/02/76	0300	3240	960	67.2	25.80	22.00	2.90	30.40	3.74	15.0	6.90	9.6	1.22	-1.0
	01/02/76	0700	3320	960	68.0	26.40	21.90	6.03	33.40	3.47	14.9	6.24	18.1	1.19	-5.4
571-2B	01/02/76	1100	2800	520	79.4	27.60	20.10	6.68	31.80	5.17	14.6	5.80	21.0	1.30	-4.6
	01/02/76	1500	2760	480	80.7	31.50	19.80	3.65	28.60	7.61	14.7	5.51	13.5	1.48	5.6
	01/02/76	1700	2560	540	76.6	30.40	18.70	5.93	29.30	7.10	12.8	4.75	20.2	1.44	2.7
	01/02/76	1900	2440	620	71.8	26.80	24.20	3.65	33.90	3.49	10.6	4.54	10.8	1.19	-5.2
	01/02/76	2100	2480	1120	49.9	25.80	21.90	8.43	35.80	2.36	12.6	5.84	23.5	1.12	-0.9
	01/02/76	2130	2500	1070	52.5	23.80	20.20	6.55	31.80	1.22	12.7	6.05	20.6	1.07	-0.1
	01/02/76	2300	2480	860	61.6	23.70	21.20	4.80	31.30	1.37	14.2	6.91	15.3	1.11	-3.1
572-2A	01/03/76	0300	2840	1060	58.6	24.60	21.20	6.60	33.10	1.27	14.5	6.62	20.0	1.07	-0.8
	01/03/76	0700	3160	980	65.6	23.60	19.20	6.10	30.10	1.71	15.3	7.45	20.3	1.10	1.4
	01/03/76	1100	3200	1180	59.1	22.10	17.90	5.53	27.90	1.65	15.0	7.85	19.8	1.11	2.1
	01/03/76	1500	3200	1140	60.5	23.60	20.50	4.98	30.60	1.38	14.9	7.38	16.3	1.08	1.7

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
572-2A	01/03/76	1900	3240	1120	61.7	22.30	18.70	3.83	27.20	1.06	13.7	7.45	14.1	1.07	0.5
	01/03/76	2300	3240	1120	61.7	22.80	18.60	4.55	27.80	1.71	14.1	7.40	16.4	1.11	5.0
	01/04/76	0300	3320	1200	59.9	22.30	18.30	4.53	27.40	2.09	14.7	7.75	16.5	1.14	2.0
	01/04/76	0700	3680	1360	59.0	22.40	19.20	2.60	26.60	1.27	15.7	8.72	9.8	1.09	9.6
	01/04/76	1100	3680	1440	56.6	22.00	18.50	3.48	26.60	1.98	15.1	8.27	13.1	1.14	3.0
	01/04/76	1500	3280	1200	59.4	22.40	19.20	2.40	26.40	1.63	14.7	8.11	9.1	1.11	0.2
	01/04/76	1900	3840	1480	57.3	23.10	20.80	1.70	27.70	1.39	14.9	8.13	6.2	1.09	0.3
	01/04/76	2300	3720	1560	53.5	23.70	21.20	2.90	29.40	1.71	14.6	7.53	9.9	1.11	3.9
	01/05/76	0300	3400	1520	50.4	22.40	17.30	5.48	27.10	1.42	14.4	7.64	20.2	1.10	7.2
	01/05/76	0700	3640	1500	54.3	21.80	17.40	4.65	26.40	1.44			17.6	1.10	6.0
	01/05/76	1100	3760	1640	51.6	22.50	16.80	6.70	27.70	1.65	14.3		24.2	1.11	4.4
	01/05/76	1500	3640	1500	54.3	22.80	20.00	4.30	29.30	1.55	14.8		14.7	1.10	1.3
	01/05/76	1900	3320	1360	54.6	23.00	20.70	4.23	30.10	1.35	14.6		14.1	1.08	0.0
	01/05/76	2300	2920	1100	58.2	23.40	17.90	6.63	29.00	1.75	14.3		22.9	1.11	3.7
	01/06/76	0300	2440	1000	54.6	23.90	18.30	7.33	30.20	1.60	13.5		24.3	1.10	3.0
	01/06/76	0700	3000	1280	52.7	24.00	21.10	5.03	31.40	0.39	14.4	7.15	16.0	1.02	6.3
	01/06/76	0701	2980	1240	53.9	24.30	20.90	5.38	31.50	0.23			17.1	1.01	0.0
	01/06/76	1100	3080	1280	53.9	24.40	21.40	6.75	33.50	0.74	14.6	6.71	20.2	1.04	0.0
	01/06/76	1500	2960	1100	58.8	23.60	21.20	5.30	31.80	1.10	13.6	6.66	16.7	1.06	-0.3
	01/06/76	1900	3000	1240	54.2	22.70	19.40	5.75	30.00	1.32	13.2	6.67	19.2	1.08	0.0
	01/06/76	2300	3520	1580	50.2	23.50	21.10	5.93	32.30	0.93	14.9	7.22	18.4	1.05	-1.3
	01/07/76	0300	3640	1640	50.0	23.10	19.70	6.48	31.10	1.16	15.4	7.52	20.8	1.07	-0.7
	01/07/76	0700	3500	1500	52.5	22.20	19.40	5.65	29.90	1.02	14.9	7.64	18.9	1.06	-0.2
	01/07/76	1100	3360	1500	50.5	23.40	21.40	5.05	31.80	0.61	14.4	7.14	15.9	1.03	1.5
	01/07/76	1500	2680	1100	54.5	21.90	14.30	10.83	28.70	0.39	16.3	8.04	37.7	1.02	5.9
	01/07/76	1900	2520	920	59.5	21.60	14.40	9.50	27.50	0.53	14.2	7.25	34.6	1.04	7.7
	01/07/76	2300	2480	1120	49.9	21.20	18.10	4.38	27.00	2.48	14.9	8.01	16.2	1.17	-4.1
	01/08/76	0300	3240	1100	62.4	20.80	17.40	4.75	26.50	0.61	15.8	8.00	17.9	1.04	7.0
	01/08/76	0700	3400	1280	58.3	20.10	13.70	6.38	23.50	1.73	13.8	7.82	27.1	1.13	7.1
	01/08/76	1100	3480	1220	61.1	20.70	14.90	5.18	23.80	1.49	12.9	7.33	21.8	1.11	10.3
	01/08/76	1500	3080	1200	56.8	19.80	15.80	3.25	23.00	2.04	13.6	8.09	14.1	1.16	5.5
	01/08/76	1900	2520	1000	56.0	19.50	13.70	5.68	22.80	1.91	14.2	8.22	24.9	1.15	5.6
	01/08/76	2300	2480	980	56.2	20.40	16.10	4.38	24.50	1.38	14.5	8.33	17.9	1.10	7.3
	01/09/76	0300	2600	1080	53.9	21.20	19.20	1.20	25.20	1.05	14.2	8.36	4.8	1.08	10.4
	01/09/76	0700	2840	1100	57.1	21.20	16.20	4.55	24.80	1.01	14.5	8.20	18.4	1.07	12.0
573-2A	01/09/76	1100	2720	760	69.0	22.70	16.80	5.30	26.30	1.39	13.6	7.22	20.2	1.10	11.0
	01/09/76	1500													
	01/10/76	0700													
	01/10/76	1500													
573-2B	01/13/76	0800	3480	600	80.9	34.00	15.50	5.03	24.40	10.92	15.5	5.24	20.6	1.81	0.0
	01/13/76	1200													
	01/13/76	1230				33.20	17.80	3.05	25.30	12.43			12.1	1.89	-1.1
	01/13/76	1260	3640	420	87.2	35.30	16.50	4.08	24.70	16.42	17.3	4.74	16.5	2.21	-0.3
	01/13/76	1300	3000	420	84.5	33.80	18.20	2.65	25.40	13.29			10.4	1.95	-2.7
	01/13/76	1330				33.10	17.20	4.90	26.40	11.49			18.6	1.79	-0.1
	01/13/76	1400	2960	400	85.1	31.90	19.10	3.93	27.80	10.57			14.1	1.69	-3.3
	01/13/76	1430				30.30	20.80	3.40	29.40	8.41			11.6	1.52	-3.3
	01/13/76	1500	2880	540	79.2	30.00	20.80	3.30	29.30	7.30			11.3	1.45	0.6
	01/13/76	1530				28.50	19.90	3.83	28.70	7.23			13.3	1.46	-2.9
	01/13/76	1600	3000	660	75.6	27.70	21.70	3.08	30.20	6.63			10.2	1.40	-6.9
	01/13/76	1630				27.50	23.00	3.45	32.20	5.30			10.7	1.30	-6.6

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
573-2B	01/13/76	1700	3000	740	72.7	25.90	23.00	0.35	29.10	4.55			1.2	1.28	-1.1
	01/13/76	1730				25.70	23.10	1.43	30.30	3.99			4.7	1.24	-2.4
	01/13/76	1800	3120	1000	64.5	25.60	22.90	3.68	32.30	2.91	15.4	7.08	11.4	1.16	-2.9
	01/13/76	1830				24.70	23.70	1.88	31.50	2.32			6.0	1.13	-1.3
	01/13/76	1900	3520	1460	54.0	24.50	22.80	3.30	31.80	1.58			10.4	1.09	0.9
	01/13/76	1930				24.40	21.50	4.53	31.40	1.63			14.4	1.09	1.7
574-2A	01/14/76	0030				28.70	19.90	4.23	29.10	8.76			14.5	1.55	-9.9
	01/14/76	0100	3040	500	81.8	28.60	18.60	4.15	27.40	9.40			15.2	1.62	-9.0
	01/14/76	0130				28.20	21.40	2.25	29.00	8.94			7.8	1.56	-12.4
	01/14/76	0200	3000	540	80.1	27.80	20.20	3.55	28.80	7.95			12.3	1.50	-9.0
	01/14/76	0230				27.00	22.60	1.45	29.70	6.25			4.9	1.38	-6.5
	01/14/76	0300	2960	620	76.8	27.30	23.50	4.23	33.60	3.62			12.6	1.20	-3.1
	01/14/76	0330				29.10	23.10	10.73	39.60	4.11			27.1	1.19	-13.3
	01/14/76	0400	2960	760	71.6	29.00	24.50	10.78	41.40	2.81			26.0	1.12	-12.3
	01/14/76	0430				28.30	24.00	9.60	39.60	2.18			24.3	1.10	-7.8
	01/14/76	0500	2960	980	63.3	28.00	23.80	9.85	39.60	1.51			24.9	1.07	-5.9
	01/14/76	0530				27.70	24.20	9.65	39.90	1.28			24.2	1.06	-6.8
	01/14/76	0600	3000	1380	49.0	27.30	22.70	10.63	39.00	1.00			27.3	1.05	-4.7
575-2A	01/15/76	1500	2600	580	75.3	26.10	22.80	4.20	32.70	3.00	13.6	6.05	12.9	1.17	-2.4
	01/15/76	1900	3200	920	66.1	24.20	18.90	6.38	30.00	3.30	14.9	6.91	21.3	1.20	-4.2
	01/15/76	2300	3100	880	68.5	25.30	23.10	4.53	33.40	1.88	15.8	7.27	13.6	1.10	-3.2
	01/16/76	0300	3160	880	69.1	23.70	18.20	6.65	29.40	3.72	14.0	6.57	22.6	1.23	-6.9
	01/16/76	0700	3200	860	70.2	24.90	24.30	3.53	33.90	1.17	14.7	6.93	10.4	1.06	-1.4
	01/16/76	1100	3200	1000	65.4	25.10	24.80	3.10	34.10	1.48	15.4	7.22	9.1	1.08	-2.7
	01/16/76	1500	3120	1040	63.1	25.00	25.70	3.18	35.30	0.88	15.3	7.11	9.0	1.05	-3.4
	01/16/76	1900	2800	920	63.6	24.00	22.40	5.30	33.30	1.16	15.3	7.21	15.9	1.06	-3.3
	01/16/76	2300	2680	820	66.1	24.40	24.60	2.15	32.90	1.04	15.1	7.47	6.5	1.06	0.1
	01/17/76	0300	2760	600	75.9	24.80	22.30	2.63	30.50	2.71	15.8	7.70	8.6	1.16	-0.1
	01/17/76	0700	2600	540	77.0	24.20	20.30	3.63	29.00	3.43	15.0	7.34	12.5	1.22	-2.0
	01/17/76	1100	3080	800	71.2	23.20	20.70	2.43	28.30	2.69	14.8	7.73	8.6	1.17	-0.2
576-2A	01/17/76	1500	3400	840	72.6	24.40	21.40	2.55	29.30	2.97	15.8	7.86	8.7	1.19	0.4
	01/17/76	1900	3520	880	72.3	25.20	16.90	5.38	26.50	6.16	15.0	6.86	20.3	1.42	-4.8
	01/17/76	2300	3560	680	78.8	26.80	21.30	3.08	29.70	5.12	14.8	6.63	10.4	1.31	-2.0
	01/18/76	0300	3040	720	73.8	26.20	22.10	2.58	30.20	4.38	14.5	6.71	8.5	1.26	-2.0
	01/18/76	0700	3400	820	73.3	23.60	21.20	3.30	29.80	2.24	14.8	7.47	11.1	1.14	-0.5
	01/18/76	1100	3520	1040	67.3	24.50	21.90	3.33	30.70	2.53	15.8	7.72	10.8	1.15	-0.9
	01/18/76	1500	3400	820	73.3	26.00	22.40	3.50	31.50	3.58	14.9	6.77	11.1	1.21	-2.4
	01/18/76	1900	3520	960	69.8	25.30	21.30	4.78	31.40	3.41	14.6	6.61	15.2	1.20	-4.1
	01/18/76	2300	3120	830	71.6	25.00	23.20	3.20	32.20	2.29	14.7	6.95	10.0	1.13	-1.9
	01/19/76	0300	3040	840	69.4	24.60	20.30	5.13	30.50	3.05	15.0	7.01	16.8	1.18	-2.6
	01/19/76	0700	3160	760	73.4	25.40	21.10	3.83	30.20	3.00	14.8	6.97	12.7	1.18	1.7
	01/19/76	1100	3240	820	72.0	26.00	21.50	4.33	31.20	3.05	14.6	6.62	13.9	1.18	1.0
	01/19/76	1500	3240	820	72.0	26.60	23.20	5.20	34.20	2.97	15.5	6.52	15.2	1.16	-4.3
	01/19/76	1900	3000	720	73.4	26.40	24.10	3.58	33.70	3.03	14.5	6.35	10.6	1.16	-4.0
	01/19/76	2300	2720	530	79.6	27.30	25.50	2.03	33.90	3.71	15.2	6.59	6.0	1.20	-4.3
	01/20/76	0300	2600	500	78.7	27.40	20.90	5.68	31.80	5.51	15.9	6.39	17.9	1.32	-6.9
	01/20/76	0700	2840	560	78.2	28.20	21.80	5.25	32.50	5.67	14.2	5.55	16.2	1.32	-6.3
	01/20/76	0701	2800	570	77.5	28.20	21.80	5.25	32.50	5.78	14.2	5.54	16.2	1.32	-6.8
	01/20/76	1100	3480	960	69.4	27.00	27.20	2.01	36.00	2.64	15.1	6.54	5.6	1.13	-5.9
	01/20/76	1500	3800	1320	61.5	25.80	24.30	5.43	35.80	1.65	15.3	6.60	15.2	1.09	-5.3
	01/20/76	1900	3880	1060	69.7	26.30	23.20	6.80	35.80	2.70	15.6	6.35	19.0	1.14	-8.4

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
576-2A	01/20/76	2300	4000	1000	72.3	27.20	19.80	10.25	35.00	2.17	15.2	5.79	29.3	1.11	-8.3
	01/21/76	0300	3600	1020	68.6	26.50	20.20	10.75	36.00	1.33	14.7	5.67	29.9	1.07	-1.6
	01/21/76	0700	2840	740	71.1	24.70	22.90	4.38	33.00	1.35	13.8	6.53	13.3	1.07	-0.6
	01/21/76	1100	2480	520	76.8	25.00	22.20	4.45	32.20	2.07	14.2	6.65	13.8	1.12	-0.8
	01/21/76	1500	2400	580	73.2	24.40	22.30	3.23	31.10	2.31	15.4	7.53	10.4	1.14	-1.3
	01/21/76	1900	3320	800	73.3	24.00	20.90	3.68	29.80	2.64	15.5	7.64	12.3	1.16	-1.0
	01/21/76	2300	3480	900	71.3	24.90	23.20	2.20	31.20	2.66	15.5	7.56	7.1	1.16	-1.4
	01/22/76	0300	3320	800	73.3	24.40	20.40	3.50	29.00	3.31	15.4	7.53	12.1	1.21	-0.5
	01/22/76	0301	3350	780	74.2	26.20	22.90	1.08	29.70	3.64	15.7	7.56	3.6	1.22	2.9
	01/22/76	0355				24.80	18.00	6.50	29.00	4.07	15.0	6.85	22.4	1.26	-2.8
576-2B	01/22/76	0430				24.70	20.00	5.10	30.10	3.58			17.0	1.22	-3.8
	01/22/76	0500	3360	1020	66.4	24.10	21.10	4.63	31.00	2.75			14.9	1.16	-4.6
	01/22/76	0530				23.40	21.80	3.65	30.90	1.93			11.8	1.11	-3.0
	01/22/76	0600	3040	1200	56.2	23.40	21.20	5.60	32.10	1.10			17.5	1.06	-2.1
	01/22/76	0630				22.80	20.80	5.00	31.00	1.27	13.5	6.76	16.1	1.07	-2.3
577-2A	01/22/76	1900	3360	780	74.3	24.00	22.60	2.65	30.90	1.87	13.5	6.81	8.6	1.11	-0.1
	01/22/76	2300	3040	480	82.5	25.20	18.90	5.38	29.00	2.36	14.8	7.05	18.5	1.15	7.5
	01/23/76	0300	3560	620	80.7	26.20	22.90	1.08	29.70	3.64	15.7	7.56	3.6	1.22	2.9
	01/23/76	0700	3800	700	79.6	26.00	21.60	2.20	29.20	4.66	14.1	6.61	7.5	1.29	-1.5
	01/23/76	1100	3560	560	82.6	27.80	19.10	6.43	30.30	5.24	15.5	6.28	21.2	1.31	-0.4
	01/23/76	1500	3000	420	84.5	28.40	25.30	1.88	33.50	4.98	15.4	6.38	5.6	1.27	-5.0
	01/23/76	1900	3040	460	83.3	28.40	24.90	2.68	33.80	4.52	14.7	6.04	7.9	1.24	-3.6
	01/23/76	2300	2880	420	83.9	28.10	22.80	4.10	32.60	4.35	14.7	6.07	12.6	1.24	-1.0
	01/24/76	0300	2880	400	84.6	33.30	25.40	4.26	36.00	5.88	15.4	4.94	11.8	1.30	1.8
	01/24/76	0700	2890	420	83.9	29.20	23.30	6.18	35.30	5.58	14.2	5.02	17.5	1.29	-9.0
	01/24/76	1100	2920	420	84.1	29.60	22.60	5.05	33.30	5.01	14.9	5.62	15.2	1.27	-0.4
	01/24/76	1500	2840	400	84.4	29.60	26.80	2.91	36.40	4.06	15.6	5.92	8.0	1.20	-3.6
	01/24/76	1900	2460	340	84.7	29.50	24.10	4.38	34.50	5.79	14.4	5.29	12.7	1.31	-6.9
	01/24/76	2300	2560	420	81.8	28.10	22.00	4.10	31.60	5.21	15.2	6.25	13.0	1.30	-2.4
	01/25/76	0300	3080	520	81.3	33.20	23.90	5.03	34.90	4.72	15.6	5.24	14.4	1.25	8.2
	01/25/76	0700	3240	520	82.2	21.20	17.70	1.88	24.00	2.99	14.9	8.54	7.8	1.23	2.7
	01/25/76	1100	3400	700	77.2	25.50	18.50	5.98	29.10	5.37	15.6	6.85	20.5	1.34	-6.8
	01/25/76	1500	3080	440	84.2	27.60	24.90	1.58	33.10	4.01	15.3	6.62	6.8	1.22	-2.5
	01/25/76	1900	3000	360	86.7	27.60	21.70	4.38	31.50	4.93	15.7	6.56	13.9	1.28	-2.7
	01/25/76	2300	3040	480	82.5	27.60	23.40	2.75	32.00	4.73	15.4	6.59	8.6	1.27	-3.1
	01/26/76	0300	2880	400	84.6	30.80	24.90	2.68	33.80	4.40	15.7	6.10	7.9	1.24	4.9
	01/26/76	0700	2760	360	85.6	28.80	20.80	5.60	31.60	4.78	14.8	5.87	17.7	1.28	2.0
	01/26/76	1100	2800	400	84.2	28.80	22.10	5.78	33.40	4.99	14.7	5.60	17.3	1.27	-3.3
	01/26/76	1500	3320	580	80.7	28.20	24.50	4.08	34.70	4.52	15.3	6.03	11.8	1.24	-6.6
	01/26/76	1900	3680	760	77.1	28.60	22.90	4.88	33.50	4.72	16.0	6.24	14.6	1.26	-3.1
	01/26/76	2300	3760	860	74.7	27.90	22.50	4.28	32.40	5.83	15.2	6.05	13.2	1.33	-8.0
	01/27/76	0300	3560	640	80.1	29.50	23.80	1.95	31.70	5.78	16.0	6.49	6.2	1.33	-0.2
	01/27/76	0700	3720	580	82.7	28.10	24.20	3.15	33.40	4.95	16.0	6.51	9.4	1.27	-5.7
	01/27/76	0701	3740	550	83.7	28.20	24.20	3.05	33.30	5.01	16.0	6.52	9.2	1.27	-5.4
	01/27/76	1100	3880	820	76.6	27.60	24.40	2.60	33.10	4.73	15.1	6.38	7.9	1.26	-5.8
	01/27/76	1500	3140	600	78.8	27.60	25.10	1.43	32.80	4.41	15.2	6.60	4.4	1.24	-3.6
	01/27/76	1900	3160	560	90.4	27.90	23.40	3.35	32.60	5.24	14.9	6.10	10.3	1.29	-5.8
	01/27/76	2300	3520	700	78.0	26.60	21.40	4.85	31.60	3.70	14.2	6.15	15.4	1.21	-0.9
	01/28/76	0300	3920	860	75.7	26.20	21.60	3.40	30.40	3.16	14.6	6.77	11.2	1.19	3.4
	01/28/76	0700	3720	760	77.4	27.20	23.10	3.53	32.40	4.46	14.3	6.12	10.9	1.25	-4.3
	01/28/76	1100	3400	660	78.5	26.40	23.30	2.58	31.70	5.34	14.2	6.22	8.1	1.31	-9.9

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
577-2A	01/28/76	1500	3280	600	79.7	27.70	25.20	3.21	34.70	5.02	15.6	6.27	9.2	1.26	-10.8
	01/28/76	1900	3240	620	78.8	26.70	22.50	9.58	37.70	5.85	15.3	5.14	25.4	1.28	-26.8
	01/28/76	2300	3200	600	79.2	28.00	24.90	3.08	34.20	4.52	14.8	6.06	9.0	1.24	-6.1
	01/29/76	0300	2760	440	82.4	28.30	23.50	5.13	34.50	4.45	14.8	5.71	14.9	1.23	-5.4
	01/29/76	0700	2880	480	81.6	29.10	24.20	3.85	34.10	5.78	15.0	5.73	11.3	1.31	-7.4
578-2A	01/29/76	1600	2840	220	91.5	29.60	21.80	3.65	31.10	8.12			12.4	1.47	-8.6
	01/29/76	1630				31.40	21.90	3.53	30.90	8.08			11.4	1.48	-1.7
	01/29/76	1700	3040	320	88.4	28.20	21.70	2.28	29.40	7.49			7.8	1.46	-6.9
	01/29/76	1730				29.00	23.00	0.85	29.60	5.97			2.9	1.37	2.3
	01/29/76	1800	3080	400	85.6	27.80	22.10	6.28	33.90	5.31			18.5	1.28	-9.8
	01/29/76	1830				26.80	23.90	2.53	32.40	5.35			7.8	1.30	-10.1
	01/29/76	1900	3120	540	80.8	27.10	25.00	3.66	34.90	3.83			10.5	1.20	-8.2
	01/29/76	1901				27.10	25.00	3.66	34.90				10.5		
	01/29/76	1930				27.30	25.80	6.76	39.00	2.66			17.3	1.12	-12.5
	01/29/76	2000	3160	640	77.6	25.60	22.70	8.13	36.50	2.92			22.3	1.15	-14.4
	01/29/76	2030				25.30	24.30	7.23	37.60	1.95			19.2	1.09	-13.9
	01/29/76	2100	3140	1110	60.8	26.20	23.50	11.33	40.70	0.96			27.8	1.04	-13.5
	01/29/76	2145				23.60	22.40	7.80	35.80	1.32			21.8	1.07	-13.4
579-2A	01/29/76	2300	3280	1040	64.9	26.30	25.40	9.56	41.30	1.51	14.5	5.24	23.1	1.07	-17.3
	01/30/76	0300	3480	1260	59.9	25.30	24.20	9.85	40.10	0.91	14.1	5.41	24.6	1.04	-15.6
	01/30/76	0700	3480	1280	59.2	26.10	24.30	6.13	36.50	0.88	15.0	6.34	16.8	1.04	-2.3
	01/30/76	1100	3360	1180	61.1	25.90	24.20	8.65	38.90	0.88	15.5	6.11	22.2	1.04	-9.5
	01/30/76	1540	3040	1000	63.5	25.70	25.00	5.06	36.30	0.94	14.5	6.33	13.9	1.05	-3.6
	01/30/76	1900	2760	940	62.2	24.00	23.20	4.30	33.30	1.16	14.0	6.72	12.9	1.06	-3.3
	01/30/76	2330	2760	840	66.3	22.20	23.20	5.40	34.40	0.52	14.9	7.28	15.7	1.03	-11.5
	01/31/76	0300	2800	1000	60.4	23.00	22.10	4.56	32.20	0.76	14.3	7.17	14.2	1.04	-2.3
	01/31/76	0300	2800	1000	60.4	23.00	22.10	4.58	32.20	0.76	14.3	7.20	14.2	1.04	-2.3
	01/31/76	0700	2840	1100	57.1	25.40	21.70	8.48	35.60	0.66	15.4	6.52	23.8	1.03	-1.5
	01/31/76	1100	2840	1040	59.4	24.50	20.30	7.93	33.30	1.21	14.9	6.66	23.8	1.07	-1.5
	01/31/76	1530	3080	1280	57.9	22.60	20.60	4.95	30.70	0.77	15.2	7.75	16.1	1.05	0.5
	01/31/76	1900	3660	1530	53.6	22.50	21.00	4.05	30.30	1.05	15.3	7.93	13.4	1.06	-0.3
	01/31/76	2300	3600	1360	58.1	23.40	19.60	8.30	32.80	0.83	15.2	7.03	25.3	1.05	-2.7
	02/01/76	0300	3000	1120	58.6	21.30	19.00	5.25	29.00	0.99	14.8	7.87	18.1	1.06	-1.3
	02/01/76	0700	2880	1060	59.2	22.10	16.70	8.63	29.50	1.38	15.5	7.60	29.2	1.09	-1.5
	02/01/76	1100	2880	1180	54.6	23.80	18.80	8.60	32.10	1.05	16.3	7.47	26.8	1.06	-0.1
580-2A	02/01/76	1530	2660	280	88.4	25.50	23.60	0.80	30.30	3.63	16.3	7.80	2.7	1.22	2.5
	02/01/76	1900	3000	600	77.9	25.10	18.20	4.35	27.10	4.57	15.4	7.37	16.1	1.31	1.2
	02/01/76	2055				25.80	20.40	4.90	30.40	3.36			16.1	1.20	0.9
	02/01/76	2130				24.60	19.50	6.13	30.50	2.86			20.1	1.17	-1.7
	02/01/76	2200	3440	1000	67.9	23.80	19.30	5.18	29.30	2.31			17.7	1.14	1.4
	02/01/76	2230				23.20	20.70	5.33	31.20	1.71			17.1	1.10	-3.6
	02/01/76	2315				22.60	21.90	4.53	31.90	0.61			14.2	1.03	-2.3
581-2A	02/04/76	2330	2760	440	84.0	27.90	22.70	8.13	36.50	2.37	16.3	6.11	22.3	1.12	-2.5
	02/05/76	0330	2940	470	82.3	28.90	22.50	9.08	37.20	2.53	15.5	5.51	24.4	1.12	-1.3
	02/05/76	0730	3220	440	84.9	30.70	23.20	9.80	38.80	1.69	15.4	5.07	25.3	1.08	4.5
	02/05/76	1130	3030	290	89.4	29.30	23.30	9.28	38.40	2.12	14.6	5.07	24.2	1.10	-1.0
	02/05/76	1530	2880	220	91.6	31.20	23.90	8.83	38.70	2.70	14.8	4.75	22.8	1.13	2.1
	02/05/76	1930	2840	210	91.8	29.70	21.80	7.55	34.80	2.59	15.2	5.71	21.7	1.14	6.8
	02/05/76	2330	2200	120	94.0	30.10	17.50	15.13	37.00	3.36	14.0	3.94	40.9	1.19	-2.9
	02/06/76	0330	2100	190	90.0	29.10	18.60	10.25	33.50	5.12	14.4	4.96	30.6	1.28	-3.1
	02/06/76	0730	2040	150	91.9	29.50	20.10	5.88	31.00	5.19	14.9	5.80	19.0	1.30	4.0

-SOLID ANALYSES AT SCRUBBER INLET-

RUN NUMBER	DATE	TIME	SO2 INLET PPM	SO2 OUTLET PPM	SO2 REMOVAL %	CAO WT %	SO2 WT %	SO3 WT %	TOTAL S AS SO3 WT. %	CO2 WT %	SLURRY SOLIDS WT. %	% ACID INSOLS IN SOLD	MOLE % SULFUR OXIDIZED	STOICH RATIO	SOLID IONIC IMBAL
581-2A	02/06/76	1130	2140	125	93.6	28.70	17.00	7.65	29.10	6.23	15.3	5.92	27.0	1.39	1.3
	02/06/76	1530	2440	160	92.8	28.40	17.30	9.58	31.20	4.74	14.9	5.61	30.7	1.28	1.8
	02/06/76	1930	2760	270	89.2	26.40	17.70	8.08	30.20	4.60	14.5	6.04	26.8	1.28	-2.3
	02/06/76	2330	2840	330	87.2	27.30	18.80	9.00	32.50	4.29	15.7	6.08	27.7	1.24	-3.4
	02/07/76	0330	2780	400	84.1	28.20	18.30	10.13	33.00	4.46	13.9	5.08	30.7	1.25	-2.1
	02/07/76	0730	2960	425	84.1	28.50	17.90	9.13	31.50	4.71	13.9	5.24	29.0	1.27	1.5
	02/07/76	1130	2930	330	87.5	25.60	18.00	5.00	27.50	4.59	14.0	6.47	18.2	1.30	1.9
	02/07/76	1530	2780	350	86.1	26.40	21.70	6.28	33.40	3.58	14.1	5.88	18.8	1.19	-5.9
	02/07/76	1930	2860	530	79.5	26.40	24.80	3.60	34.60	1.53	14.5	6.53	10.4	1.08	0.8
	02/07/76	2330	2980	590	78.1	27.40	19.00	12.85	36.60	2.48	15.0	5.19	35.1	1.12	-5.1
	02/08/76	0330	2940	660	75.1	28.20	18.00	14.60	37.30	2.48	15.0	4.76	39.7	1.12	-3.9
	02/08/76	0730	2850	540	79.0	25.50	19.60	5.80	30.30	2.63	15.2	6.95	19.2	1.16	3.6
	02/08/76	1130	2580	450	80.7	26.40	18.70	8.33	31.70	3.26	14.9	6.21	26.3	1.19	0.2
	02/08/76	1530	2620	450	81.0	25.10	19.60	7.80	32.30	3.32	15.0	6.45	24.2	1.19	-7.0
	02/08/76	1930	2580	410	82.4	24.70	18.70	9.63	33.00	3.05	14.7	6.19	29.2	1.17	-9.3
	02/08/76	2330	2560	410	82.3	26.60	18.80	10.40	33.90	3.14	15.4	5.93	30.7	1.17	-4.3
	02/09/76	0330	2560	390	83.1	24.80	17.20	10.10	31.60	3.25	15.1	6.34	32.0	1.19	-6.0
	02/09/76	0700	2540	400	82.6	22.10	15.60	8.40	27.90	3.34	14.4	6.92	30.1	1.22	-7.7
	02/09/76	1130	2360	335	84.3	21.60	15.60	7.10	26.60	3.40	16.0	8.09	26.7	1.23	-6.3
	02/09/76	1530	2440	250	88.7	23.00	19.00	8.15	31.90	1.35	15.4	7.24	25.6	1.08	-4.6
	02/09/76	1930	3400	610	80.1	21.90	18.30	9.33	32.20	1.14	14.7	6.93	29.0	1.06	-9.6
	02/09/76	2330	3480	700	77.7	26.00	19.50	12.73	37.10	1.98	15.3	5.55	34.3	1.10	-9.7
	02/10/76	0330	3480	720	77.1	26.80	21.40	10.75	37.50	1.54	15.2	5.61	28.7	1.07	-5.3
	02/10/76	0730	3660	860	74.0	26.10	20.90	10.08	36.20	1.49	15.4	6.04	27.8	1.07	-4.4
	02/10/76	1130	3440	660	78.8	25.30	18.90	10.18	33.80	2.20	15.7	6.40	30.1	1.12	-4.7
	02/10/76	1530	3260	700	76.2	25.80	18.60	13.25	36.50	1.33	14.8	5.44	36.3	1.07	-5.7
	02/10/76	1930	2620	470	80.1	26.20	23.10	8.93	37.80	0.81	20.4	8.04	23.6	1.04	-5.0
	02/10/76	2330	2840	465	81.9	25.10	22.30	3.33	31.20	1.41	15.7	7.67	10.7	1.04	5.8
	02/11/76	0330	2960	490	81.7	29.00	21.20	11.50	38.00	1.53	15.6	5.28	30.3	1.07	1.5
	02/11/76	0730	3040	490	82.5	28.00	16.50	14.48	35.10	3.69	14.9	4.86	41.2	1.19	-4.6
	02/11/76	1130	2880	410	84.2	29.50	21.50	11.43	38.30	3.03	14.9	4.72	29.8	1.14	-4.0
5P2-2A	02/11/76	1530	2800	200	92.1	32.20	18.90	13.18	36.80	5.94	17.0	4.39	35.8	1.29	-3.6
	02/11/76	1930	2620	90	96.2	35.80	14.70	10.23	28.60	10.95	15.2	5.83	35.8	1.70	5.1
	02/12/76	0100	2920	100	96.2	38.80	15.10	10.73	29.60	13.81			36.2	1.85	1.2
	02/12/76	0130				37.70	16.20	10.55	30.80	12.43			34.3	1.73	0.8
	02/12/76	0200	2880	120	95.4	36.30	17.20	8.60	30.10	12.82			28.6	1.77	-3.1
	02/12/76	0230				34.70	17.70	9.28	31.40	10.40			29.5	1.60	-1.6
	02/12/76	0300	2900	240	90.9	34.10	17.40	9.85	31.60	10.12			31.2	1.58	-2.7
	02/12/76	0330				34.40	19.00	10.15	33.90	9.74			30.0	1.52	-5.1
	02/12/76	0400	2980	300	88.9	33.20	19.60	9.55	34.30	8.20			27.9	1.43	-3.8
	02/12/76	0430				33.00	20.50	11.18	36.80	6.55			30.4	1.32	-3.4
	02/12/76	0500	2960	480	82.1	29.30	20.50	8.38	34.00	6.22			24.6	1.33	-8.3
	02/12/76	0530				28.40	20.30	9.33	34.70	4.90			26.9	1.26	-7.6
	02/12/76	0600	3000	800	70.5	28.60	21.50	9.93	36.80	3.74			27.0	1.19	-6.8
	02/12/76	0630				27.70	20.80	9.30	35.30	3.47			26.4	1.18	-5.2
	02/12/76	0700	3040	1100	59.9	28.00	20.90	11.58	37.70	1.87			30.7	1.09	-2.8
	02/12/76	0710				27.70	21.40	11.25	38.00	1.54			29.6	1.07	-3.2

The following codes are used in the database tables as indicated below:

Lime or Limestone Column

L = lime addition

LS = limestone addition

Alkali Addition Point Column

DNC = alkali added into downcomer from the scrubber before entering the effluent hold tank

EHT = effluent hold tank

MgO and Fly Ash Columns

N = no

Y = yes

Spray Tower Header Configuration

1 = spray nozzle bank 1 (the lowest) on

2 = spray nozzle bank 2 (second lowest) on

3 = spray nozzle bank 3 (second from top) on

4 = spray nozzle bank 4 (top header) on

Mist Eliminator System Configuration Column

1-3P/OV = one three-pass, open-vane mist eliminator installed

2-3P/CV = two three-pass, closed-vane mist eliminators installed

Mist Eliminator Wash, Bottom/Top Column

I = intermittent wash (see Summary Table for details)

C = continuous

i.e. I/C = intermittent bottom wash/continuous top wash

Dewatering System Column

CL = clarifier used for thickening solids for disposal

CE = centrifuge used for thickening solids for disposal

F = filter used for thickening solids for disposal

i. e. CL/CE = clarifier and centrifuge used in series

TCA Sphere Type Column

TPR = thermoplastic rubber spheres used in TCA beds

Foam = solid nitrile foam spheres used in TCA beds

Appendix E

TEST RESULTS SUMMARY TABLES
FOR THE VENTURI/SPRAY TOWER

Table E-1

SUMMARY OF LIME RELIABILITY TESTS ON VENTURI/SPRAY TOWER SYSTEM

Run No.	601-1A			602-1A	603-1A
Start-of-Run Date	10/9/73			3/15/74	4/2/74
End-of-Run Date	1/8/74			4/1/74	4/19/74
On Stream Hours	2153			393	395
Gas Rate, acfm @ 330°F	25,000			25,000	25,000
Spray Tower Gas Vel, fps @ 125°F	6.7			6.7	6.7
Venturi/Spray Tower Liquor Rates, gpm	600/1200			600/1200	600/1200
Spray Tower L/G, gal/mcf	60			60	60
Percent Solids Recirculated	7-9			7.5-9.5	13.5-16
Effluent Residence Time, min.	12			12	12
Solids Disposal System	Clarifier Only (10/9-11/7)	Clarif & Intermittent Filter (11/7-12/15)	Clarifier & Filter (12/15-1/8)	Clarifier & Filter	Clarifier & Filter
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.01-1.28	1.02-1.18	1.04-1.19	1.02-1.18	1.00-1.13
Avg % Lime Utilization, 100x moles SO_2 abs./mole Ca added	87	91	90	91	94
Inlet SO_2 Concentration, ppm	1600-3900	1600-4000	2100-4400	2100-3850	2100-4300
Percent SO_2 Removal	68-91	75-95	75-95	87-97	85-98
Scrubber Inlet pH Range	7.4-8.5	7.5-8.5	7.7-8.4	7.6-8.3	7.8-8.2
Scrubber Outlet pH Range	4.7-5.5	4.7-5.5	4.8-5.3	4.9-5.4	4.8-5.3
Percent Sulfur Oxidized	10-30	10-30	10-30	5-28	12-22
Loop Closure, % Solids Dischg.	20-26	20-27	42-52	42-48	46-94
Calculated Avg % Sulfite Saturation in Scrubber Inlet Liquor @ 50°C	150	120	180	165	135
Dissolved Solids, ppm	5700-7500	4600-7300	9800-12,300	9500	8200-10,900
Total ΔP Range, Excluding Mist Eliminator in. H_2O	11.0-11.5	11.0-12.0	11.7-12.3	11.0-12.0	11.0-12.0
Venturi ΔP, in. H_2O	9	9	9	9	9
Mist Eliminator ΔP, in. H_2O	0.16-0.31	0.21-0.51	0.51-1.26	0.19-0.27	0.16-0.33
Absorbent	Lime slurried to 20 wt% with makeup water and added to EHT.			Lime slurried to 20 wt% with makeup water and added to EHT.	Lime slurried to 20 wt% with makeup water and added to EHT.
Mist Eliminator	10/9 - 12/15: Bottom washed with available makeup water (~14 gpm) plus available clarified liquor (~26 gpm). Continuous wash rate of 0.8 gpm/ft². 12/15 - 1/8: Bottom washed with available makeup water (~5 gpm) plus available clarifier liquor (~45 gpm). Wash rate of 1 gpm/ft² on cycle of 3-1/2 min on/1-1/2 min off. Also, top was washed once/wk with fresh water for 5 min during last 4 wks.			Bottom washed with available makeup water (~5 gpm) plus available clarified liquor (~34 gpm). Wash rate of 1 gpm/ft² on cycle of ~ 4 min on/1 min off.	Bottom washed with available makeup water (~5 gpm) plus available clarified liquor (~21 gpm). Wash rate of 1 gpm/ft² on cycle of ~ 1-1/2 min on/1-1/2 min off.
Scrubber Internals	All nozzles (7/header) on top 3 headers sprayed downward. Bottom header nozzles (7) sprayed upward.			All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	System (scrubber and mist eliminator) cleaned.			System cleaned chemically (Na_2CO_3/sugar/limestone/flyash soln.) followed by mech. cleaning. EHT sealed. Installed external combustion reheater. Changed nozzles on bottom spray header to spray downward instead of upward. Capped middle nozzles on bottom header.	Mist eliminator cleaned.
Method of Control	Scrubber inlet pH controlled at 8.0 ± 0.2			Scrubber inlet pH controlled at 8.0 ± 0.2	Scrubber inlet pH controlled at 8.0 ± 0.2
Run Philosophy	Initially started as lime reliability verification test. Subsequently, due to apparent reliability of the run, decision was made that test continue as long-term reliability test.			Intended long-term. Sealed EHT in attempt to reduce sulfite oxidation and thereby degree of sulfite saturation.	Intended long-term. Recirculated 15% solids in attempt to reduce degree of sulfate saturation. EHT sealed.
Results	Routine inspection on 11/7/74 showed system was generally clean after 644 hours of operation with clarifier only for solids disposal. Run was terminated on 1/8/74 due to ID fan vibration and rapidly increasing pressure drop across mist. elim. Sulfate based scale formed on most scrubber walls and in slurry piping. Top of mist eliminator 80% restricted with solids that fell from outlet duct-work. Mist eliminator top vanes heavily scaled (300 mils avg.).			Run terminated due to scale (125 mils avg) and solids deposits on mist eliminator top vanes. Sulfite oxidation and sulfate saturation were not reduced. Steady state operation not achieved.	Degree of sulfate saturation was reduced, but run was terminated due to scale (60 mils avg.) and solids buildup on the mist eliminator top vanes.

Table E-1 (continued)

Run No.	604-1A	605-1A	606-1A	608-1A
Start-of-Run Date	6/26/74	7/31/74	8/7/74	8/21/74
End-of-Run Date	7/15/74	8/6/74	8/14/74	9/17/74
On Stream Hours	1828	141	170	610
Gas Rate, acfm @ 330°F	25,000	25,000	25,000	25,000
Spray Tower Gas Vel. fps @ 125°F	6.7	6.7	6.7	6.7
Venturi/Spray Tower Liquor Rates, gpm	min. (~100)/1200	min. (~100)/1200	min. (~100)/1200	600/1200
Spray Tower L/G, gal/mcf	60	60	60	60
Percent Solids Recirculated	7.5-9.0	8.0-9.3	7.7-9.0	7.7-9.4
Effluent Residence Time, min.	17	17	17	12
Solids Disposal System	Clarifier & Filter	Clarifier & Filter	Clarifier	Clarifier & Filter
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.03-1.30	1.10-1.17	1.10-1.15	1.05-1.25
Avg % Lime Utilization, 100x moles SO_2 abs./mole Ca added	88	88	89	87
Inlet SO_2 Concentration, ppm	2000-3800	2900-3300	2400-3200	2000-3750
Percent SO_2 Removal	70-92	73-81	67-79	75-95
Scrubber Inlet pH Range	7.7-8.4	8.8-9.2	7.8-8.2	7.6-8.4
Scrubber Outlet pH Range	4.5-5.4	4.9-5.1	5.0-5.2	4.8-5.1
Percent Sulfur Oxidized	8-30	12-28	12-22	12-28
Loop Closure, % Solids Dischg.	50-60	48-52	18-23	48-58
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	130	115	120	130
Dissolved Solids, ppm	11,600-13,700	6,000-7,400	5,000-7,000	7,500-9,500
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	3.3-3.8	3.2-3.9	3.6-3.7	11.5-12.0
Venturi ΔP, in. H_2O	1.2-1.5 (Plug 100% open)	1.5-2.0 (Plug 100% open)	1.9-2.3 (Plug 100% open)	9
Mist Eliminator ΔP, in. H_2O	0.20-1.25	0.23-0.28	0.23-0.31	0.22-0.44
Absorbent	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt% with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt% with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt% with makeup water and added to scrubber downcomer.
Mist Eliminator	Bottom washed with available makeup water (~5 gpm) plus available clarified liquor (~35 gpm). Wash rate of 1 gpm/ft² on cycle of ~3 1/2 min on/1 1/2 min off.	Bottom washed with available makeup water only (~5 gpm). Wash rate of 0.4 gpm/ft² on cycle of ~1 min on/4 min. off.	Bottom washed continuously with 15 gpm (0.3 gpm/ft²) raw water only. (Rate was greater than available makeup water).	Bottom washed with available makeup water only (~5.5 gpm). Wash rate of 150 gpm (3 gpm/ft²) for approx. 9 min. every 4 hours.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	Mist eliminator and outlet duct cleaned. Sealed EHT provided with N_2 gas purge. Tank overflow blanked. Lime slurry makeup added to scrubber downcomer.	System cleaned.	Mist eliminator cleaned.	Mist eliminator cleaned. Provided for Freon gas blanket over EHT.
Method of Control	Scrubber inlet pH controlled at 8.0 ± 0.2	Scrubber inlet pH controlled at 9.0 ± 0.2	Scrubber inlet pH controlled at 8.0 ± 0.2	Scrubber inlet pH controlled at 8.0 ± 0.2
Run Philosophy	Intended 2 wks. To observe sulfite oxidation and degree of sulfate saturation with lime add'n to downcomer, minimum slurry rate to venturi, sealed EHT purged with N_2 gas, and 8% solids recirculated.	Intended long-term. Control at higher pH in attempt to reduce sulfite oxidation and thereby degree of sulfate saturation. Wash mist eliminator with water only.	Intended short-term. Mist eliminator washed continuously with raw water only (at rate greater than available makeup water).	Int'd 2 wks. 12 min res time, venturi in service. EHT sealed with Freon. Mist elim. on 4 hr wash cycle. Observe effects of lime add'n to downcomer and sealed EHT (compare with Run 601-1A).
Results	Degree of sulfate saturation was about 130%. Solids from outlet duct fell to top of mist eliminator. Run was terminated due to heavy scale (400 mils avg.) and solids buildup on mist eliminator.	Run was terminated due to scale formation (up to 140 mils) on top mist eliminator vanes.	Run was terminated due to scale formation (50 mils avg.) on top mist eliminator vanes.	Run terminated due to slight increase in mist eliminator ΔP. Inspection revealed scale buildup (88 mils avg.) on the mist eliminator top vanes.

Table E-1 (continued)

Run No.	609-1A	610-1A	611-1A	618-1A
Start-of-Run Date	9/20/74	10/2/74	10/25/74	11/21/74
End-of-Run Date	10/2/74	10/13/74	11/11/74	12/2/74
On Stream Hours	277	253	392	235
Gas Rate, acfm @ 330°F	25,000	25,000	25,000	25,000
Spray Tower Gas Vel, fps @ 125°F	6.7	6.7	6.7	6.7
Venturi/Spray Tower Liquor Rates, gpm	600/1200	600/1200	600/1200	min (~100)/1200
Spray Tower L/G, gal/mcf	60	60	60	60
Percent Solids Recirculated	7.9-9.0	7.8-8.6	8.0-9.3	7.5-9.6
Effluent Residence Time, min.	24	24	6	17
Solids Disposal System	Clarifier & Filter	Clarifier & Filter	Clarifier & Filter	Clarifier
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.07-1.25	1.10-1.25	0.93-1.05[(a)]	1.15-1.22
Avg % Lime Utilization, 100x moles SO_2 abs./mole Ca added	87	85	101[(a)]	84
Inlet SO_2 Concentration, ppm	2250-3600	1800-3800	2250-3750	2600-4250
Percent SO_2 Removal	88-96	87-98	96-99	57-79
Scrubber Inlet pH Range	7.6-8.6	7.8-8.4	6.9-7.2	7.0-8.3
Scrubber Outlet pH Range	4.7-5.4	4.8-6.0	5.4-6.3	4.8-5.1
Percent Sulfur Oxidized	12-30	16-26	15-28	10-28
Loop Closure, % Solids Dischg.	47-52	43-48	44-49	16-21
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	110	110	45	140
Dissolved Solids, ppm	8,000-10,000	9,000-12,000	17,000-21,000	4,100-6,100
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	11.0-11.9	11.0-12.2	10.4-12.0	3.65-4.25
Venturi ΔP, in. H_2O	9	9	9	1.8-1.9 (Plug 100% open)
Mist Eliminator ΔP, in. H_2O	0.23-0.28	0.20-0.33	0.55-0.60	0.50-0.60
Absorbent	Lime slurried to 20 wt% with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt% with makeup water and added to effluent hold tank.	Lime slurried to 20 wt% with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt% with makeup water and added to scrubber downcomer.
Mist Eliminator	Btm washed with makeup wtr @ 2.7 gpm/ft² for ~ 5 min every 4 hrs. Simultaneous top wash with remaining makeup wtr at 1 gpm/ft² through a single nozzle covering about 14 ft². Tot. makeup wtr ≃ 5 gpm avg.	Btm washed with makeup wtr @ 2.7 gpm/ft² for ≥ 8 min every 4 hrs. Simultaneous top wash with remaining makeup wtr at 1 gpm/ft² through a single nozzle covering about 14 ft². Tot. makeup wtr ≃ 5 gpm avg.	Bottom washed continuously at 0.69 gpm/ft² using a mixture of ≥ 5 gpm fresh water and 35 gpm clarified liquor.	Bottom washed continuously at 0.26 gpm/ft² using 15 gpm raw water (three times required makeup water rate).
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 5 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 5 nozzles on bottom header.
System Changes Before Start of Run	Mist eliminator and outlet duct cleaned. A single nozzle installed to provide top wash for one section of mist eliminator and several holes drilled in the top vanes of a second section.	Relocated lime addition to effluent hold tank.	System cleaned. Installed sloped mist eliminator and MgO feeder. Relocated lime addition to scrubber downcomer. Effluent hold tank agitator lowered.	System cleaned
Method of Control	Scrubber inlet pH controlled at 8.0 ± 0.2.	Scrubber inlet pH controlled at 8.0 ± 0.2.	Scrubber inlet pH controlled at 7.0 ± 0.2.	Scrubber inlet pH controlled at 8.0 ± 0.2.
Run Philosophy	Intended 2 wks. To observe the effect of mist eliminator top wash (on one section) and the effect of increased residence time on sulfate saturation.	Intended 2 wks. To observe the effect on sulfate saturation of lime addition to the effluent hold tank vs addition to the downcomer.	To verify the ability to run unsaturated with respect to calcium sulfate with MgO add'n at 6 min. effluent residence time.	Intended 1 wk. To observe rate of scale buildup on sloped mist eliminator using a continuous fresh water bottom wash.
Results	Run terminated as planned. Sulfate saturation reduced to 110%. Mist eliminator top vanes clean where top washed.	Run terminated as planned. Sulfate saturation 145%. Mist eliminator top vanes clean where top washed.	Run terminated as planned. Sulfate saturation 49% at a magnesium ion level of 3000 ppm. [(a)] Total stoich. ratio for Ca & Mg is 0.96-1.08 (Avg. alkali util. is 98 %).	Run terminated as planned. 20-25% of underside of mist eliminator area was 50-100% plugged with mud and scale. The underside of the mist eliminator top vanes had ~100 mils scale.

Table E-1 (continued)

Run No.	619-1A	621-1A	622-1A	623-1A
Start-of-Run Date	12/19/74	1/18/75	1/30/75	3/12/75
End-of-Run Date	1/2/75	1/23/75	3/5/75	3/19/75
On Stream Hours	327	113	787	162
Gas Rate, acfm @ 330°F	25,000	25,000	25,000	25,000
Spray Tower Gas Vel, fps @ 125°F	6.7	6.7	6.7	6.7
Venturi/Spray Tower Liquor Rates, gpm	600/1200	600/1200	600/1200	600/1200
Spray Tower L/G, gal/mcf	60	60	60	60
Percent Solids Recirculated	7-10	8-9	7.2-8.8	7.4-8.9
Effluent Residence Time, min.	12	12	17	17
Solids Disposal System	Clarifier & Filter	Clarifier & Filter	Clarifier and Centrifuge (or filter)	Clarifier & Centrifuge
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.07-1.23	1.20-1.27	1.06-1.20	1.07-1.17
Avg % Lime Utilization, 100x moles SO_2 abs./mole Ca added	87	81	88	89
Inlet SO_2 Concentration, ppm	1150-4000	1600-3600	2200-3900	2700-3700
Percent SO_2 Removal	70-98	82-95	71-91	74-88
Scrubber Inlet pH Range	7.3-8.3	7.8-8.3	7.1-8.3	7.7-8.3
Scrubber Outlet pH Range	4.9-5.7	5.2-5.6	4.7-5.3	4.85-5.1
Percent Sulfur Oxidized	14-34	12-26	12-28	11-21
Loop Closure, % Solids Dischg.	53-60	57-61	50-62	53-60
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	125	130	115	105
Dissolved Solids, ppm	6400-8000	5600-6500	6500-10,000	7000-8400
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	10.8-12.0	11.3-12.0	11.1-12.5	11.4-11.7
Venturi ΔP, in. H_2O	9	9	9	9
Mist Eliminator ΔP, in. H_2O	0.60-1.10	0.63-0.70	0.20-0.30	0.17-0.20
Absorbent	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.
Mist Eliminator	Bottom washed with makeup water at 2.6 gpm/ft^2 for ~8 min every 4 hrs. Total makeup ~5 gpm avg.	Bottom washed continuously at 0.69 gpm/ft^2 using a mixture of ~5 gpm fresh water and ~35 gpm clarified liquor.	Bottom washed with makeup water at 3.0 gpm/ft^2 for ~8 min every 4 hrs. Total makeup ~5 gpm avg.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Btm washed with remaining makeup wtr at 3 gpm/ft^2 for ~3.5 min every 4 hrs.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	Mist eliminator cleaned in place. Effluent hold tank agitator raised to original level.	Mist eliminator removed and cleaned.	Installed new open-vane, horizontal mist eliminator at an elevation 1 foot higher than previous open-vane, horizontal mist eliminator.	Cleaned mist eliminator and outlet duct. Installed mist eliminator sequential topwash system.
Method of Control	Scrubber inlet pH controlled at 8.0±0.2.	Scrubber inlet pH controlled at 8.0±0.2.	Scrubber inlet pH controlled at 8.0±0.2.	Scrubber inlet pH controlled at 8.0±0.2.
Run Philosophy	Intended 2 wks. To observe the rate of scale buildup on sloped mist eliminator using an intermittent, high pressure fresh water bottom wash.	Intended 2 wks. To observe the rate of scale/solids buildup on the sloped mist eliminator washed with a continuous bottomwash using all available makeup water and clarified liquor.	Intended 2 wks. To establish base conditions for the performance of the new open-vane (of old design) mist eliminator with underside washing only.	Intended long term. To observe the rate of scale/solids buildup on the mist eliminator with bottom wash and sequential topwash.
Results	Run terminated as planned. The mist eliminator was 25-30% restricted but the test was invalid since 3 of the 9 mist eliminator underwash nozzles had lost alignment causing uneven wash coverage.	Run terminated as planned. Bottom of mist eliminator top vane coated with solids (60 mils avg.).	Run terminated as planned. Mist eliminator 5% restricted by scale and solids.	Run terminated in order to test higher gas velocities when inspection revealed the mist eliminator to be clean with only a light scattered dust on the mist eliminator vanes.

Table E-1 (continued)

Run No.	624-1A	625-1A	626-1A	627-1A
Start-of-Run Date	3/19/75	6/20/75	7/9/75	8/5/75
End-of-Run Date	4/23/75	7/9/75	8/4/75	8/13/75
On Stream Hours	823	319	569	187
Gas Rate, acfm @ 330°F	30,000	30,000	35,000	35,000
Spray Tower Gas Vel, fps @ 125°F	8.0	8.0	9.4	9.4
Venturi/Spray Tower Liquor Rates, gpm	600/1200	600/1200	600/1400	600/1400
Spray Tower L/G, gal/mcf	50	50	50	50
Percent Solids Recirculated	7-10	7.5-9	8-9	14.8-15.8
Effluent Residence Time, min.	17	12	12	20
Solids Disposal System	Clarifier & Centrifuge	Clarifier & Filter	Clarifier & Filter	Clarifier & Filter
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.03-1.20	1.00-1.25	1.05-1.30	1.15-1.33
Avg % Lime Utilization, 100x moles SO_2 abs./mole Ca added	90	89	85	82
Inlet SO_2 Concentration, ppm	2250-3750	2000-3350	1750-3250	1400-3500
Percent SO_2 Removal	70-87	67-90	68-88	69-93
Scrubber Inlet pH Range	7.8-8.3	7.6-8.6	7.7-8.3	8.0-8.2
Scrubber Outlet pH Range	4.8-5.2	4.4-5.3	4.8-5.2	4.7-6.25
Percent Sulfur Oxidized	12-30	12-38	12-32	12-19
Loop Closure, % Solids Dischg.	48-58	55-60	52-60	52-56
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	95	115	100	65
Dissolved Solids, ppm	6000-10,000	8500-12,500	8000-12,000	7900-10,000
Total $\triangle P$ Range, Excluding Mist Eliminator, in. H_2O	12.0-12.4	11.9-12.4	14.2-15	14-15.4
Venturi $\triangle P$, in. H_2O	9	9	9	9
Mist Eliminator $\triangle P$, in. H_2O	0.25-0.35	0.15-0.30	0.37-0.40	0.37-0.42
Absorbent	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt % with makeup water and added to EHT.
Mist Eliminator	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Btm washed with remaining makeup wtr at 3 gpm/ft^2 for ~4.3 min every 4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 4.5 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4hrs.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	No changes.	System cleaned.	No changes.	Fan damper cleaned.
Method of Control	Scrubber inlet pH controlled at 8.0±0.2.	Scrubber inlet pH controlled at 8.0±0.2.	Scrubber inlet pH controlled at 8.0±0.2.	Scrubber inlet pH controlled at 8.0±0.2.
Run Philosophy	Attempt to operate at an increased gas velocity (8.0 vs 6.7 ft/sec).	Intended short term to test mist eliminator reliability at one-half the bottom wash rate used in Run 624-1A.	Attempt to operate at an increased gas velocity (9.4 vs 8.0 ft/sec).	Attempt to operate at a gas vel. of 9.4 ft/sec with 15% solids recirc. Also to determine sulfate sat. with increased % solids recirc., higher res. time (20 min vs 12 min) and lime add'n to the EHT.
Results	Run terminated due to Boiler #10 routine maintenance outage. Mist eliminator 100 percent clean after 823 operating hours.	Run terminated as planned. Mist eliminator essentially clean except for a light dust covering (<2% restricted).	Run terminated as planned. Mist eliminator condition unchanged during run. (< 2% restricted).	Run terminated as planned to start variable load testing. System developed sulfite/carbonate scale due to low sulfur coal (max. outlet pH = 6.25). Scale diminishing at end of run. Mist elim 2-3% restricted (1075 hrs since last cleaning).

Table E-1 (continued)

Run No.	628-1A	628-1B	
Start-of-Run Date	8/16/75	9/18/75	
End-of-Run Date	9/18/75	10/7/75	
On Stream Hours	717	426	
Gas Rate, acfm @ 330°F	17,000-35,000	19,000-35,000	
Spray Tower Gas Vel, fps @ 125°F	4.5-9.4	5.1-9.4	
Venturi/Spray Tower Liquor Rates, gpm	600/1400 (through 8/25) 600/1600 (after 8/25)	600/1600	
Spray Tower L/G, gal/mcf	50-117	57-105	
Percent Solids Recirculated	8-12	8-10	
Effluent Residence Time, min.	12	12	
Solids Disposal System	Clarifier & Filter	Clarifier & Filter	
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.04-1.16	1.04-1.17	
Avg % Lime Utilization, 100x moles SO_2 abs. /mole Ca added	91	90	
Inlet SO_2 Concentration, ppm	1900-4400	2000-4000	
Percent SO_2 Removal	70-98	72-96	
Scrubber Inlet pH Range	6.2-8.2	7.1-8.3	
Scrubber Outlet pH Range	4.5-5.5	4.3-5.3	
Percent Sulfur Oxidized	10-30	14-27	
Loop Closure, % Solids Dischg.	52-59	52-56	
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	100	90	
Dissolved Solids, ppm	5500-9000	6700-10,000	
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	10.4-14.6	6.5-14.6	
Venturi ΔP, in. H_2O	9	4.0-9.0	
Mist Eliminator ΔP, in. H_2O	0.08-0.45	0.10-0.40	
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	
Absorbent	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	Lime slurried to 20 wt % with makeup water and added to scrubber downcomer.	
Mist Eliminator	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	
System Changes Before Start of Run	System cleaned.	No cleaning. Venturi plug position held constant.	
Method of Control	Scrubber outlet pH controlled at 5.0±0.5. Override: Inlet pH ≤ 8.0	Scrubber outlet pH controlled at 5.0±0.5. Override: Inlet pH ≤ 8.0	
Run Philosophy	Attempt to test operability and controllability of system under cycling gas load. With venturi plug ΔP fixed at 9 in. H_2O. Gas flow range corresponds to 60-100 Mw of boiler load.	Attempt to test operability and controllability of system under cycling gas load with fixed venturi plug position (ΔP = 9 in. H_2O at max. gas rate).	
Results	Run terminated as planned. Mist eliminator 2% restricted. No problems experienced controlling system.	Run terminated as planned. Mist eliminator unchanged since end of 628-1A (2% restricted). No problems experienced controlling system.	

Table E-2

SUMMARY OF LIMESTONE TESTS ON THE VENTURI/SPRAY TOWER SYSTEM

Run No.	701-1A	702-1A	703-1A	704-1A
Start-of-Run Date	10/9/75	10/14/75	10/19/75	11/3/75
End-of-Run Date	10/12/75	10/17/75	11/1/75	11/6/75
On Stream Hours	73	60	319	66
Gas Rate, acfm @ 330°F	35,000	35,000	35,000	35,000
Spray Tower Gas Vel, fps @ 125°F	9.4	9.4	9.4	9.4
Venturi/Spray Tower Liquor Rates, gpm	600/1600	600/1400	600/1400	600/1400
Spray Tower L/G, gal/mcf	57	50	50	50
Percent Solids Recirculated	14.4-17	14.8-15.9	14-16	15.2-16.3
Effluent Residence Time, min.	20	20	20	20
Solids Disposal System	Clarifier & Filter	Centrifuge	Centrifuge	Centrifuge
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.3-1.65	1.2-1.7	1.0-1.15	1.2-1.7
Avg % Limestone Utilization, 100x moles SO_2 abs. /mole Ca added	68	68	93	69
Inlet SO_2 Concentration, ppm	2400-3250	2600-4200	2000-4000	2600-4200
Percent SO_2 Removal	84-92	74-92	50-68	81-91
Scrubber Inlet pH Range	5.8-6.0	5.7-5.9	5.1-5.3	5.6-6.0
Scrubber Outlet pH Range	5.45-5.65	-	4.6-4.8	5.0-5.65
Percent Sulfur Oxidized	9-22	5-13	4-22	10-40
Loop Closure, % Solids Dischg.	58-63	58-65	60-67	59-65
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	30	25	100	55
Dissolved Solids, ppm	8000-9400	7000-8400	10,500-13,000	8700-12,700
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	14.5-15.0	13.9-14.6	14.1-15.0	14.6-14.7
Venturi ΔP, in. H_2O	9	9	9	9
Mist Eliminator ΔP, in. H_2O	0.35-0.70	0.35-0.60	0.30-0.40	0.35-0.76
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Eliminator System Washing Scheme	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	Reheater cleaned.	Mist eliminator cleaned.	Mist eliminator cleaned.	No changes.
Method of Control	Scrubber inlet pH controlled at 5.9±0.1.	Scrubber inlet pH controlled at 5.9±0.1.	Scrubber inlet pH controlled at 5.2±0.1.	Scrubber inlet pH controlled at 5.9±0.1. Override: Stoich. Ratio ≤ 1.8
Run Philosophy	First limestone reliability test on the venturi/spray tower system.	Test conditions chosen identical to Run 627-1A (except inlet pH) to compare mist eliminator performance when different alkali used.	Observe operability of mist eliminator under low stoichiometry conditions (low scrubber inlet pH).	Limestone utilization data run and replication of Run 702-1A to reconfirm severe mist eliminator fouling.
Results	Run terminated when inspection revealed mist eliminator to be 50-60% restricted with solids.	Run terminated when inspection revealed mist eliminator to be 45-50% restricted with solids.	Run terminated after 319 hours. Mist eliminator 1% restricted and showing evidence of descaling.	Run terminated after 66 hours. Mist eliminator 45-50% restricted.

Table E-2 (continued)

Run No.	705-1A	706-1A	707-1A	708-1A
Start-of-Run Date	11/7/75	11/13/75	11/21/75	11/26/75
End-of-Run Date	11/13/75	11/21/75	11/26/75	12/2/75
On Stream Hours	136	180	118	138
Gas Rate, acfm @ 330°F	35,000	35,000	35,000	35,000
Spray Tower Gas Vel, fps @ 125°F	9.4	9.4	9.4	9.4
Venturi/Spray Tower Liquor Rates, gpm	600/1500	600/1400	600/1400	600/1400
Spray Tower L/G, gal/mcf	54	50	50	50
Percent Solids Recirculated	14.6-15.8	14-15	14.3-16	14.2-15.4
Effluent Residence Time, min.	20	12	12	12
Solids Disposal System	Clarifier & Filter	Clarifier & Filter	Clarifier & Filter	Clarifier & Filter
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.1-1.[illegible]	1.0-1.08	1.15-1.35	1.05-1.25
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	83	96	80	87
Inlet SO_2 Concentration, ppm	2800-3900	2370-3800	2700-4200	2600-4200
Percent SO_2 Removal	78-89	53-63	79-85	61-87
Scrubber Inlet pH Range	5.6-6.0	5.1-5.4	5.6-5.8	5.4-5.9
Scrubber Outlet pH Range	4.95-5.7	4.7-5.0	5.3-5.5	5.0-5.45
Percent Sulfur Oxidized	2-18	9-28	3-24	1-25
Loop Closure, % Solids Dischg.	53-66	54-75	58-73	59-65
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	40	125	45	55
Dissolved Solids, ppm	5700-8700	8300-9600	7000-9000	7100-9800
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	14.0-15.1	14.5-15.2	14.0-14.9	14.8-15.2
Venturi ΔP, in. H_2O	9	9	9	9
Mist Eliminator ΔP, in. H_2O	0.35-0.43	0.30-0.40	0.25-0.43	0.43-0.5[illegible]
Mist Elimination System Configuration	3 pass, open-vane, 316L SS, chevron mist eliminator.	3 pass, open-vane, 316L SS, chevron mist eliminator.	3 pass, open-vane, 316L SS, chevron mist eliminator.	3 pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Eliminator System Washing Scheme	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	Mist eliminator and fan damper cleaned. Clarifier feed well extended to 8 feet.	Mist eliminator cleaned.	No changes.	No changes.
Method of Control	Scrubber inlet pH to be controlled at 5.5±0.1. Override: 1.0≤Stoich. Ratio≤1.4	Scrubber inlet pH controlled at 5.2±0.1.	Stoichiometric ratio controlled at 1.25 moles Ca/mole SO_2 absorbed.	Stoichiometric ratio controlled at 1.1 moles Ca/mole SO_2 absorbed.
Run Philosophy	Limestone utilization data run and study of the effect of intermediate pH and stoich. ratio on mist eliminator operability.	Observe effect of lower residence time on limestone utilization (vs. Run 703-1A).	Limestone utilization run and observation of mist eliminator operability with increased intermittant wash frequency in conjuction with limestone utilization run.	Limestone utilization data run and observation of a fouled mist eliminator when stoichiometric ratio reduced to 1.1.
Results	Mist eliminator 17-20% restricted.	Limestone utilization was 96%. Mist eliminator was 1% restricted.	Mist eliminator 10-15% restricted at end of run.	Mist eliminator restriction increased from 10-15% to 15-20%.

Table E-2 (continued)

Run No.	709-1A	710-1A	711-1A	711-1B
Start-of-Run Date	12/6/75	12/12/75	12/24/75	12/30/75
End-of-Run Date	12/12/75	12/22/75	12/30/75	1/2/75
On Stream Hours	134	234	144	71
Gas Rate, acfm @ 330°F	35,000	35,000	35,000	35,000
Spray Tower Gas Vel, fps @ 125°F	9.4	9.4	9.4	9.4
Venturi/Spray Tower Liquor Rates, gpm	600/1400	600/1400	600/1400	600/1400
Spray Tower L/G, gal/mcf	50	50	50	50
Percent Solids Recirculated	14.5-16	14-16	14.2-15	14-16
Effluent Residence Time, min.	12	12	6	6
Solids Disposal System	Centrifuge	Clarifier & Centrifuge	Centrifuge	Centrifuge
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.15-1.35	1.4-1.6	1.14-1.42	1.3-1.54
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	80	67	78	70
Inlet SO_2 Concentration, ppm	2800-4400	2500-4000	2600-3900	2500-3500
Percent SO_2 Removal	74-86	79-97	73-87	78-84
Scrubber Inlet pH Range	5.6-6.0	5.8-6.2	5.4-6.0	5.5-5.9
Scrubber Outlet pH Range	5.35-5.65	5.55-5.85	5.0-5.5	5.05-5.2
Percent Sulfur Oxidized	6-23	1-26	2-26	4-22
Loop Closure, % Solids Dischg.	61-65	57-63	59-65	56-62
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	30	25	65	85
Dissolved Solids, ppm	5500-6900	5100-6800	4600-9600	10,000-12,700
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	13.7-14.4	14.3-15	14.5-15.4	14.5-15.4
Venturi ΔP, in. H_2O	9	9	9	9
Mist Eliminator ΔP, in. H_2O	0.33-0.40	0.33-0.40	0.35-0.40	0.33-0.38
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Eliminator System Washing Scheme	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed continuously with dil. clar. liq. at 0.4 gpm/ft^2.	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed continuously with dil. clar. liq. at 0.4 gpm/ft^2.	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed continuously with dil. clar. liq. at 0.4 gpm/ft^2.	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed continuously with dil. clar. liq. at 0.4 gpm/ft^2.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	Mist eliminator cleaned.	No changes.	EHT agitator lowered. No cleaning.	No changes.
Method of Control	Stoichiometric ratio controlled at 1.25 moles Ca/mole SO_2 absorbed.	Stoichiometric ratio controlled at 1.5 moles Ca/mole SO_2 absorbed.	Stoichiometric ratio controlled at 1.25 moles Ca/mole SO_2 absorbed.	Scrubber inlet pH controlled at 5.6±0.1.
Run Philosophy	Limestone utilization data run and observation of mist eliminator operability with a continuous underwash at a stoichiometric ratio of 1.25.	Limestone utilization data run.	Limestone utilization data run to observe the effect of low residence time on the pH vs. utilization relationship and on saturation.	Continuation of 711-1A with control method changed to inlet pH controlled at 5.6±0.1.
Results	Mist eliminator <1% restricted.	Mist eliminator 5-7% restricted.	Run terminated when control method changed due to difficulties in controlling stoichiometric ratio at a low residence time.	Limestone utilization was 70%. Mist eliminator was 5-7% restricted.

Table E-2 (continued)

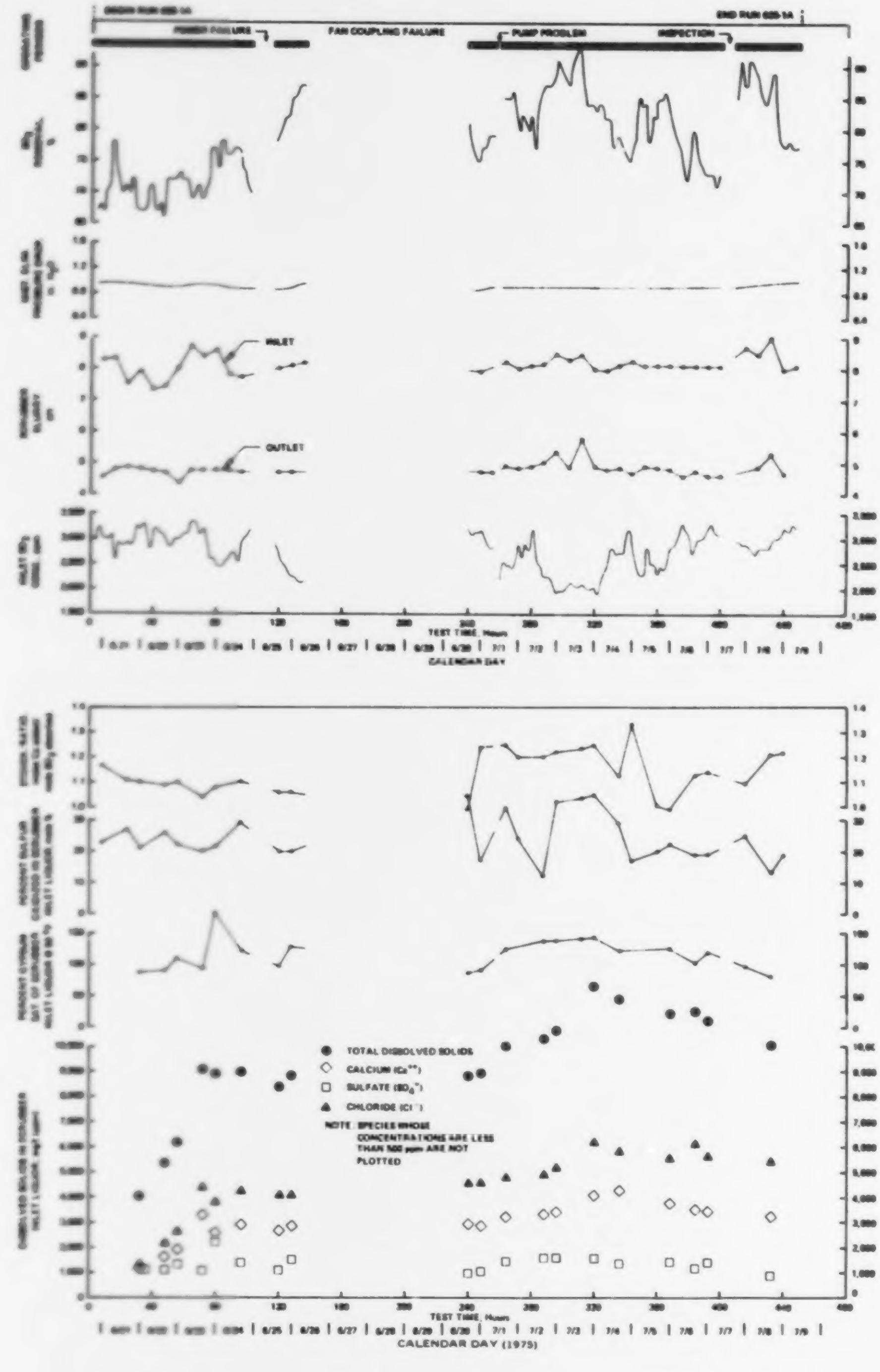
Run No.	712-1A	713-1A	714-1A	715-1A
Start-of-Run Date	1/2/76	1/8/76	1/19/76	1/26/76
End-of-Run Date	1/7/76	1/10/76	1/26/76	1/27/76
On Stream Hours	119	52	157	23
Gas Rate, acfm @ 330°F	35,000	35,000	35,000	35,000
Spray Tower Gas Vel,fps @ 125°F	9.4	9.4	9.4	9.4
Venturi/Spray Tower Liquor Rates, gpm	600/1400	600/1400	600/1400	600/0
Spray Tower L/G, gal/mcf	50	50	50	0
Percent Solids Recirculated	14.7-15.8	14-15	14.5-16	14-18
Effluent Residence Time, min.	6	6	6	20
Solids Disposal System	Centrifuge	Centrifuge	Centrifuge	Centrifuge
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.3-1.55	1.05-1.35	1.15-1.35[a]	1.3-1.55[b]
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	70	83	80[a]	70[b]
Inlet SO_2 Concentration, ppm	2600-4000	2600-3260	2300-3800	3200-3400
Percent SO_2 Removal	84-91	69-80	84-97	17-32
Scrubber Inlet pH Range	5.6-6.1	5.15-5.4	5.3-5.8	4.9-5.6
Scrubber Outlet pH Range	5.15-5.65	-	-	-
Percent Sulfur Oxidized	3-19	8-25	9-21	9-20
Loop Closure, % Solids Dischg.	60-63	59-60	57-62	56-66
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	25	120	95	110
Dissolved Solids, ppm	6,500-10,700	10,400-12,100	25,000-30,500	26,000-28,500
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	14.6-15.2	14.3-15.3	14.6-15.6	13.1-13.9
Venturi ΔP, in. H_2O	9	9	9	9
Mist Eliminator ΔP, in. H_2O	0.36-0.40	0.38-0.40	0.33-0.40	0.35-0.40
Mist Elimination System Configuration	3-pass, open-vane, 316L SS chevron mist eliminator.	3-pass, open-vane, 316 L SS. chevron mist eliminator.	3-pass, open-vane, 316L SS. chevron mist eliminator.	3-pass, open-vane, 316L SS. chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with makeup water and added to EHT.	Limestone slurried to 60 wt % with makeup water and added to EHT.
Mist Eliminator System Washing Scheme	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed continuously with dil. clar. liq. at 0.4 gpm/ft^2.	Top washed sequentially with fresh water. Each nozzle (6 total) on 3 min (at 0.5 gpm/ft^2) with 7 min off between nozzles. Bottom washed continuously with dil. clar. liq. at 0.4 gpm/ft^2.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	No changes.	No changes.	Mist eliminator cleaned.	No changes.
Method of Control	Stoichiometric ratio controlled at 1.5 moles Ca/mole SO_2 absorbed.	Scrubber inlet pH controlled at 5.2±0.1.	Stoichiometric ratio controlled at 1.2 moles Ca/mole SO_2 absorbed.	Stoichiometric ratio controlled at 1.2 moles Ca/mole SO_2 absorbed.
Run Philosophy	Limestone utilization data run to observe the effect of low residence time on the pH vs. utilization relationship and on saturation.	Limestone utilization data run to observe the effect of low residence time on the pH vs. utilization relationship and on saturation.	To observe the effect of MgO addition on the pH vs. utilization relationship and on SO_2 removal at 5000 ppm liquor Mg^{++} concentration.	To observe the effect of MgO addition on the pH vs. utilization relationship and on SO_2 removal at 5000 ppm liquor Mg^{++} concentration, with venturi only operation.
Results	Limestone utilization was 70%. Mist eliminator was 10-15% restricted.	Average limestone utilization was 83%. Mist eliminator was 10-12% restricted.	Average limestone utilization was 80%. Mist eliminator was 2% restricted. [a] Total stoich. ratio for Ca & Mg is 1.18-1.39 (avg. alkali util. = 78%).	Average limestone utilization was 70%. Run terminated due to SO_2 evolution from EHT and centrifuge and possible blinding of limestone by calcium sulfite solid. [b] Total stoich. ratio for Ca & Mg is 1.34-1.59 (avg. alkali util. = 68%).

Table E-2

Run No.	716-1A	717-1A
Start-of-Run Date	1/27/76	1/28/76
End-of-Run Date	1/28/76	2/5/76
On Stream Hours	18	181
Gas Rate, acfm @ 330°F	35,000	35,000
Spray Tower Gas Vel, fps @ 125°F	9.4	9.4
Venturi/Spray Tower Liquor Rates, gpm	600/0	600/1400
Spray Tower L/G, gal/mcf	0	50
Percent Solids Recirculated	13-16	14.5-16
Effluent Residence Time, min.	20	6
Solids Disposal System	Centrifuge	Centrifuge
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.6-2.35[a]	1.1-1.25[b]
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	51[a]	85[b]
Inlet SO_2 Concentration, ppm	3200-4000	2700-3700
Percent SO_2 Removal	6-20	80-96
Scrubber Inlet pH Range	4.65-5.0	5.3-5.6
Scrubber Outlet pH Range	-	5.15-5.4
Percent Sulfur Oxidized	8-24	3-24
Loop Closure, % Solids Dischg.	70-73	53-59
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	120	90
Dissolved Solids, ppm	33,500-34,500	23,000-31,000
Total ΔP Range, Excluding Mist Eliminator, in. H_2O	12.9-13.8	13.6-15.6
Venturi ΔP, in. H_2O	9	9
Mist Eliminator ΔP, in. H_2O	0.35-0.40	0.25-0.50
Mist Elimination System Configuration	3-pass, open-vane, 316L SS. chevron mist eliminator.	3-pass, open-vane, 316 L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with makeup water and added to EHT.	Limestone slurried to 60 wt % with makeup water and added to EHT.
Mist Eliminator System Washing Scheme	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.	Top washed sequentially with fresh water. Each nozzle (6 total) on 4 min (at 0.5 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 1.5 gpm/ft^2 for 6 min (constant)/4 hrs.
Scrubber Internals	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.	All nozzles on 4 headers sprayed downward. 7 nozzles/header on top 3 headers. 6 nozzles on bottom header.
System Changes Before Start of Run	No changes.	No changes.
Method of Control	Stoichiometric ratio controlled at 1.1 moles Ca/mole SO_2 absorbed.	Stoichiometric ratio controlled at 1.1 moles Ca/mole SO_2 absorbed.
Run Philosophy	To observe the effect of MgO addition on the pH vs. utilization relationship and on SO_2 removal at 5000 ppm liquor Mg^{++} concentration, with venturi only operation.	To observe the effect of MgO addition on the pH vs. utilization relationship and on SO_2 removal at 5000 ppm liquor Mg^{++} concentration.
Results	Average limestone utilization was 51%. Run terminated due to SO_2 evolution from EHT and centrifuge and possible blinding of limestone by calcium sulfite solid. [a] Total stoich. ratio for Ca & Mg is 1.65-2.42 (avg. alkali util. = 49%).	Average limestone utilization was 85%. Mist eliminator was 0% restricted. [b] Total stoich. ratio for Ca & Mg is 1.13-1.29 (avg. alkali util. = 83%).

Appendix F

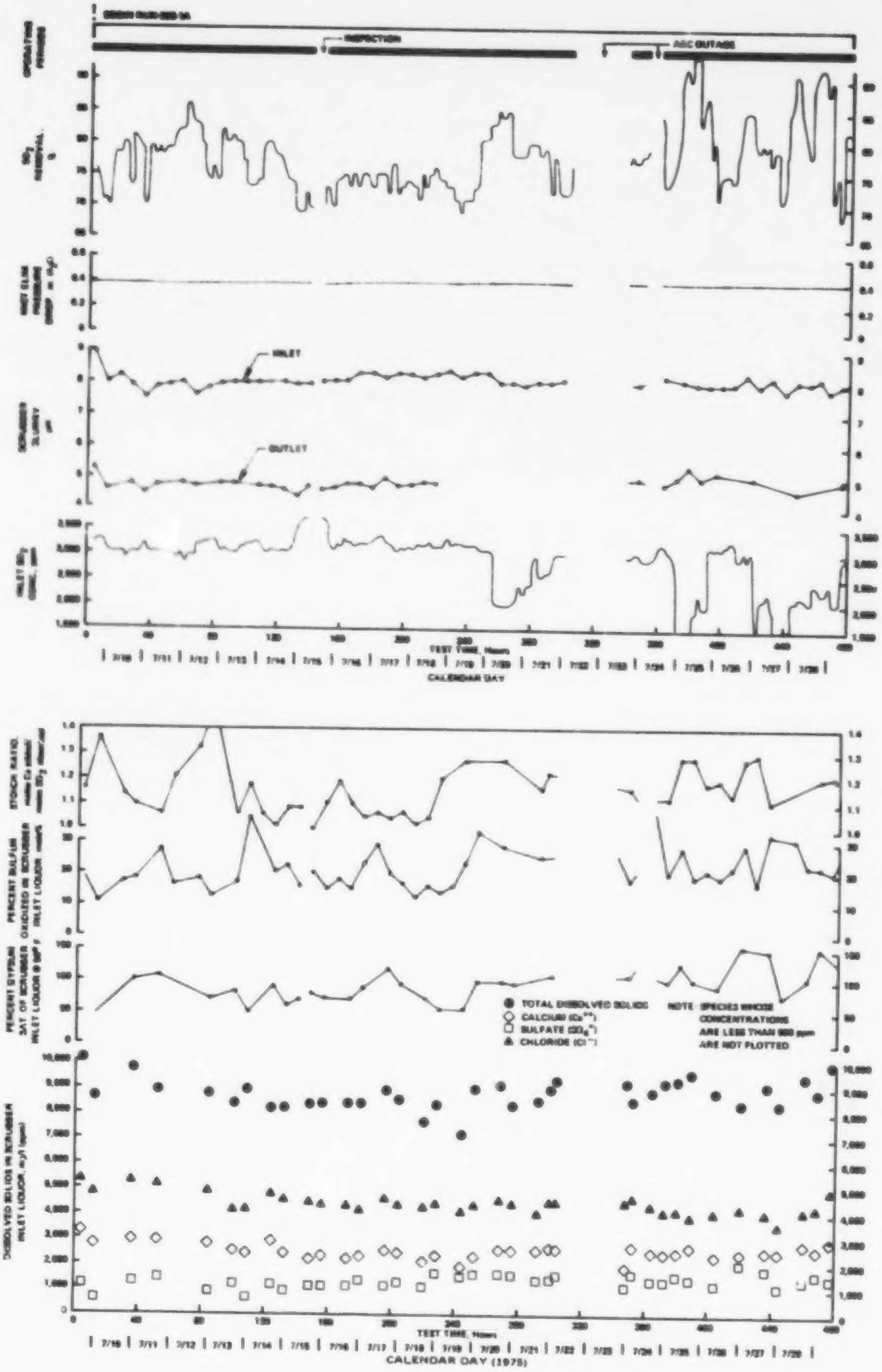
GRAPHICAL OPERATING DATA FROM THE VENTURI/SPRAY TOWER TESTS



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 8.0 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1200 gpm
Venturi L/G = 25 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min

Percent Solids Recirculated = 7.5-9 wt %
Venturi Pressure Drop = 9 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 11.9-12.4 in. H_2O
Scrubber Inlet Liquor Temperature = 124-130 °F
Liquid Conductivity = 6,000-10,000 μ mhos/cm
Discharge (Clarifier and Filter) Solids
Concentration = 55-60 wt %
Lime Addition to Scrubber Downcomer

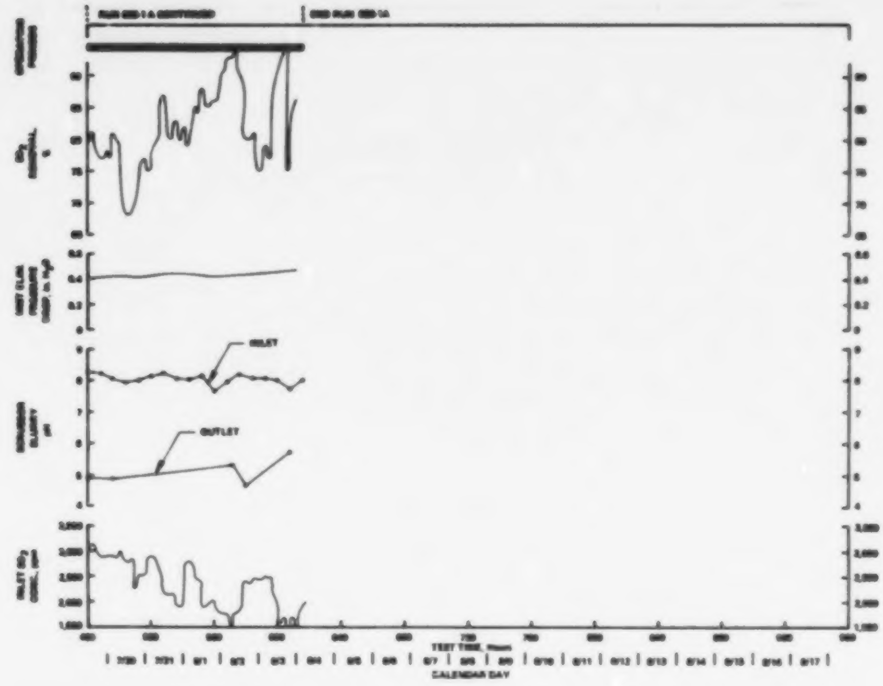
Figure F-1. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 625-1A

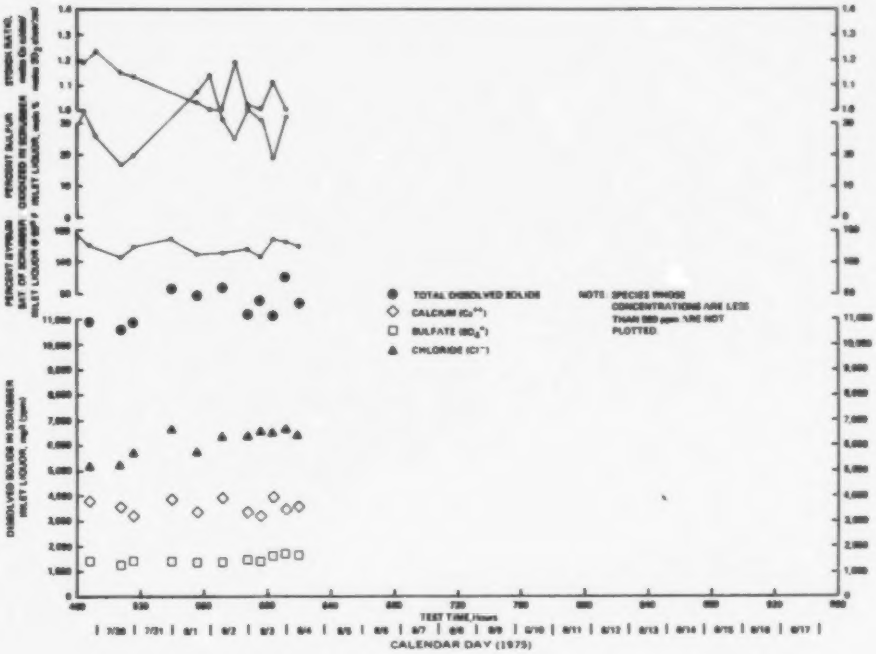


Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min

Percent Solids Recirculated = 8-9 wt %
Venturi Pressure Drop = 9 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.2-15 in. H_2O
Scrubber Inlet Liquor Temperature = 128-133 °F
Liquid Conductivity = 11,000-17,000 μ mhos/cm
Discharge (Clarifier and Filter) Solids
Concentration = 52-60 wt %
Lime Addition to Scrubber Downcomer

Figure F-2. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 626-1A

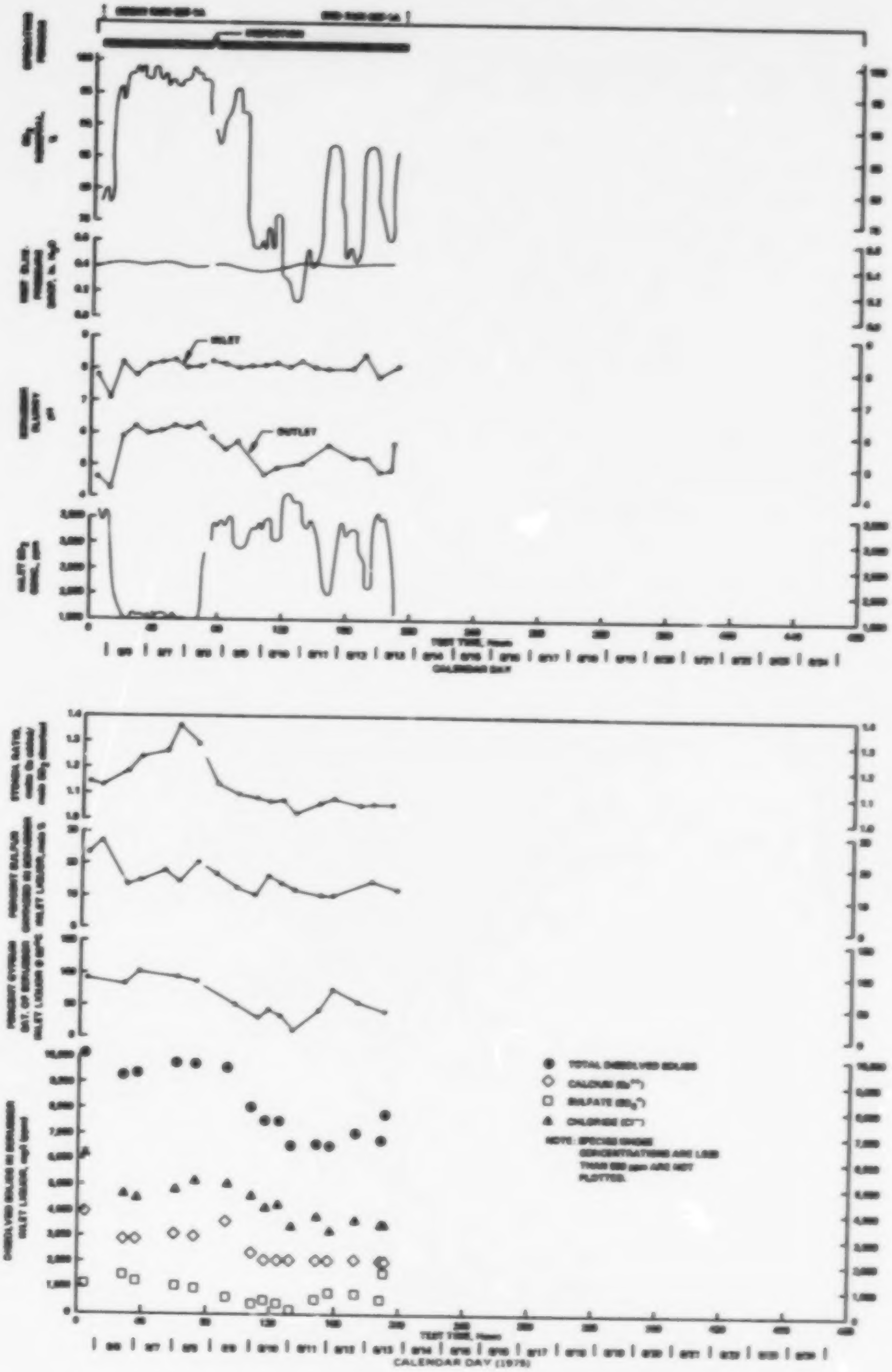




Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Liquor L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time - 12 min

Percent Solids Recirculated = 6-8 wt %
Venturi Pressure Drop = 8 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.2-15 in. H_2O
Scrubber Inlet Liquor Temperature = 130-133 °F
Liquid Conductivity = 11,000-17,000 μ mhos/cm
Discharge (Clarifier and Filter) Solids
Concentration = 55-60 wt %
Lime Addition to Scrubber Downcomer

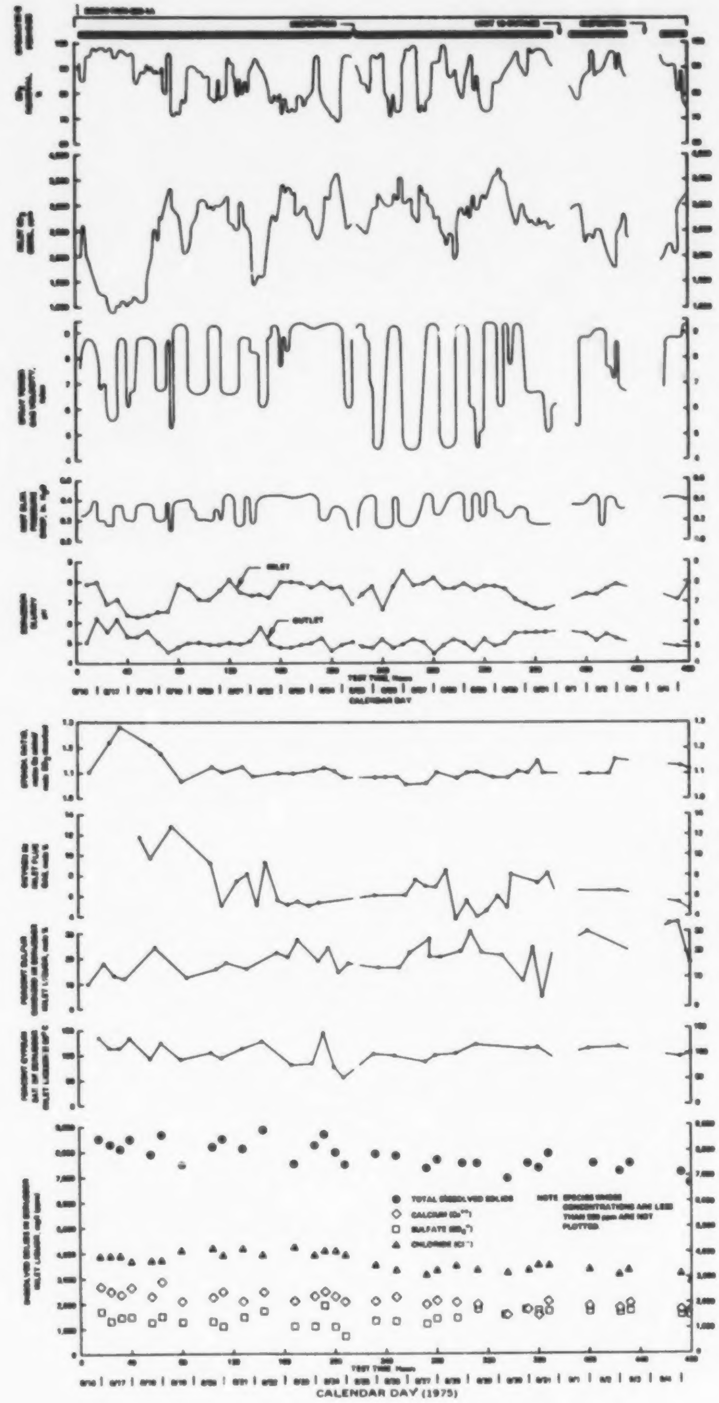
Figure F-3. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 626-1A (Continued)



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,600 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 20 min

Percent Solids Recirculated = 14.4-15.2 wt %
Venturi Pressure Drop = 9 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14-15.4 in. H_2O
Scrubber Inlet Liquor Temperature = 126-133 °F
Liquid Conductivity = 7,500-11,225 μ mhos/cm
Discharge (Clarifier and Filter) Solids
Concentration = 53-56 wt %
Lime Addition to EHT

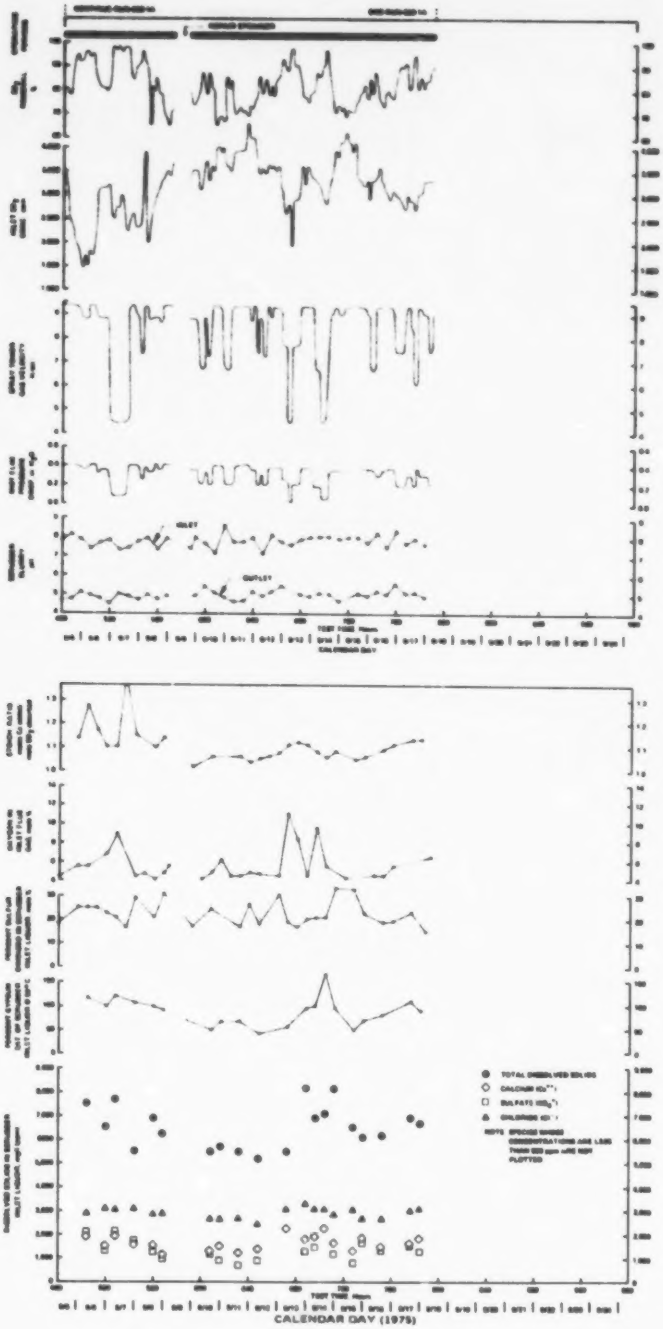
Figure F- 4. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 627 - 1A



Gas Rate = 17,000-36,000 acfm @ 330 °F
Spray Tower Gas Velocity ≈ 4.5-8.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400, 1,600 (after 8/25)
Venturi L/G = 21-44 gal/mcf
Spray Tower L/G = 50-117 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min

Percent Solids Recirculated = 8.8-11.4 wt %
Venturi Pressure Drop = 9 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 10.3-14.3 in. H_2O
Scrubber Inlet Liquor Temperature = 124-133 °F
Liquid Conductivity = 8,200-11,400 μ mhos/cm
Discharge (Clarifier and Filter) Solids
Concentration = 51-55 wt %
Lime Addition to Scrubber Downcomer

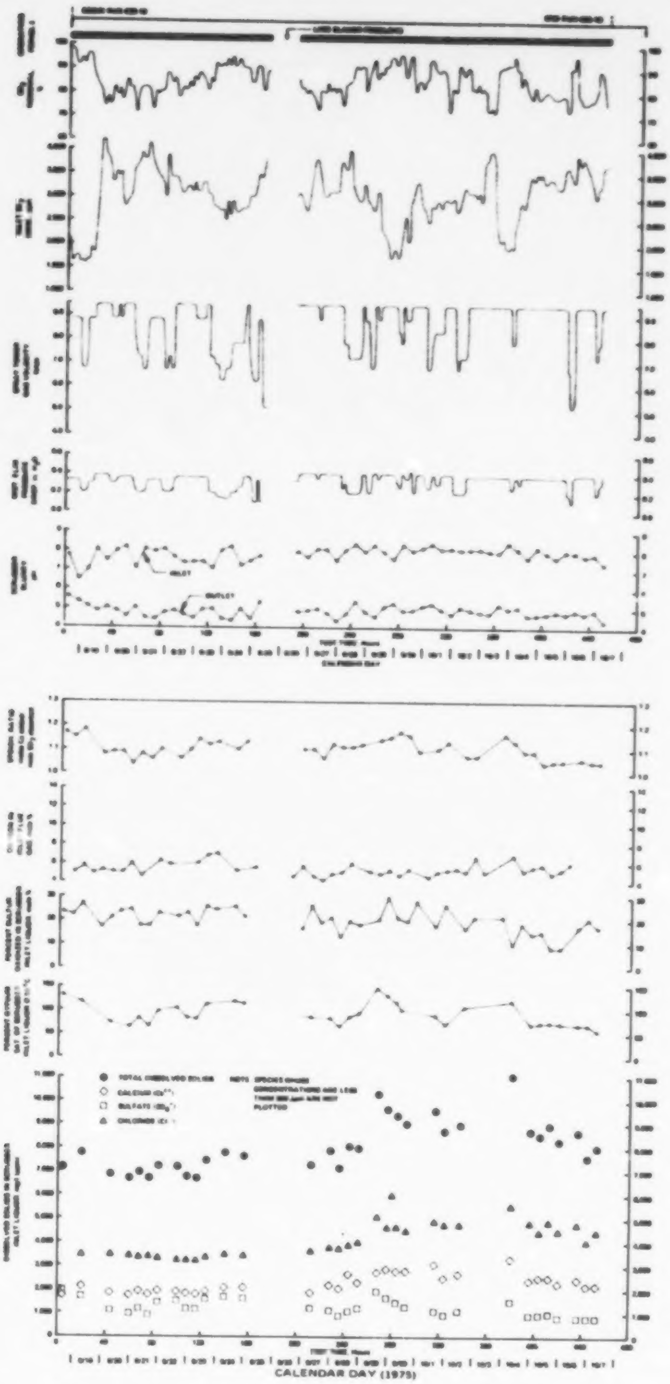
Figure F-5. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 628 - 1A



Gas Rate = 17,000-35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 4.5-9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400, 1,000 (after 8/25)
Venturi L/G = 21-44 gal/mcf
Spray Tower L/G = 50-117 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min

Percent Solids Recirculated = 9-12 wt %
Venturi Pressure Drop = 9 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 10.4-14.6 in. H_2O
Scrubber Inlet Liquor Temperature = 129-132 °F
Liquid Conductivity = 7,000-8,000 μ mhos/cm
Discharge (Clarifier and Filter) Solids
Concentration = 52-58 wt %
Lime Addition to Scrubber Downcomer

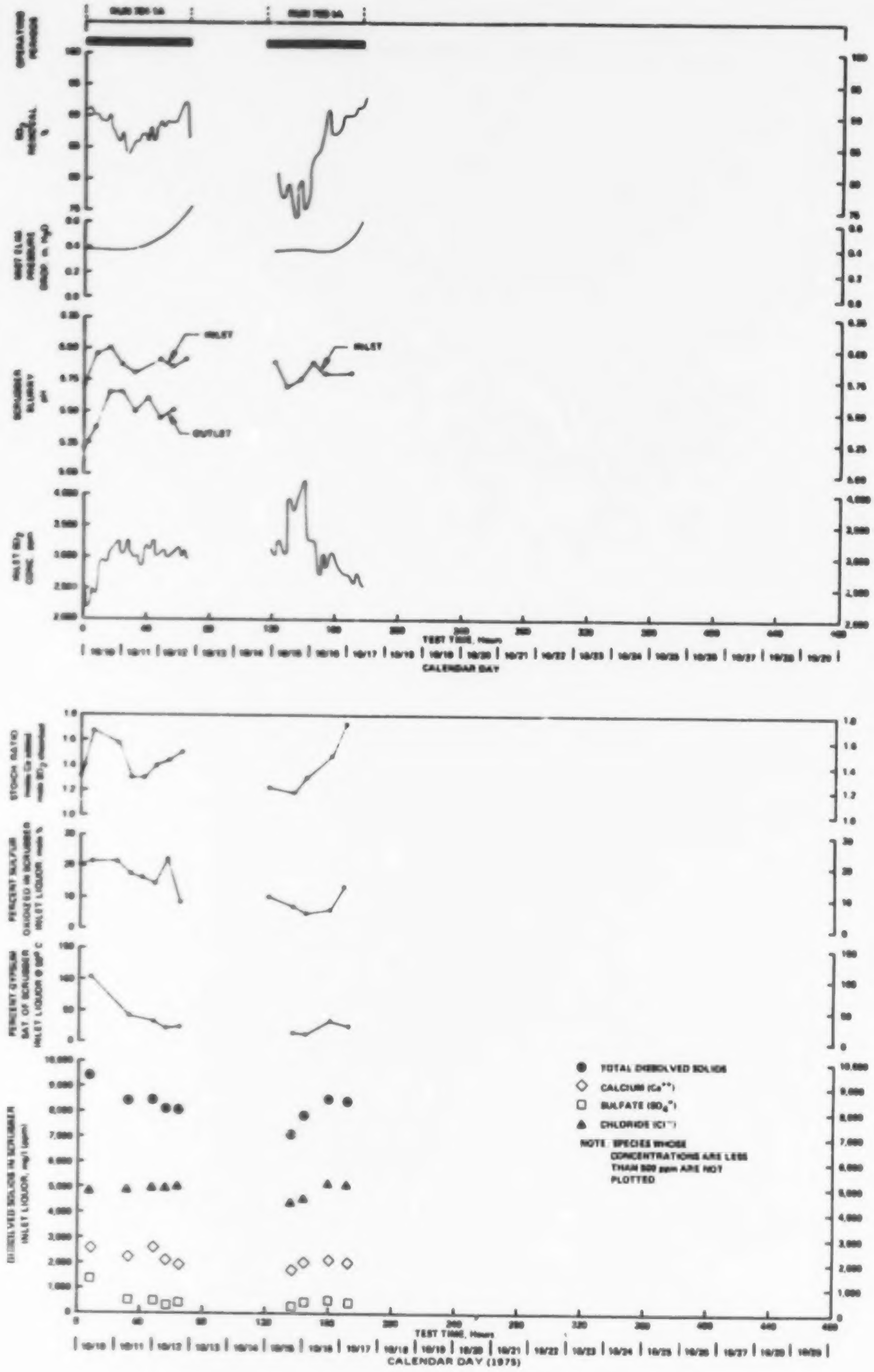
Figure F-6. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 628 - 1A (Continued)



Gas Rate = 19,000 - 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 5.1-9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,600 gpm
Venturi L/G = 21-38 gal/mcf
Spray Tower L/G = 57-105 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min

Percent Solids Recirculated = 8.6-9.7 wt %
Venturi Pressure Drop = 4.0-9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 6.5-14.6 in. H_2O
Scrubber Inlet Liquor Temperature = 129-131 °F
Liquid Conductivity = 8,000-11,500 μ mhos/cm
Discharge (Clarifier and Filter) Solids
Concentration = 52-58 wt %
Lime Addition to Scrubber Downcomer

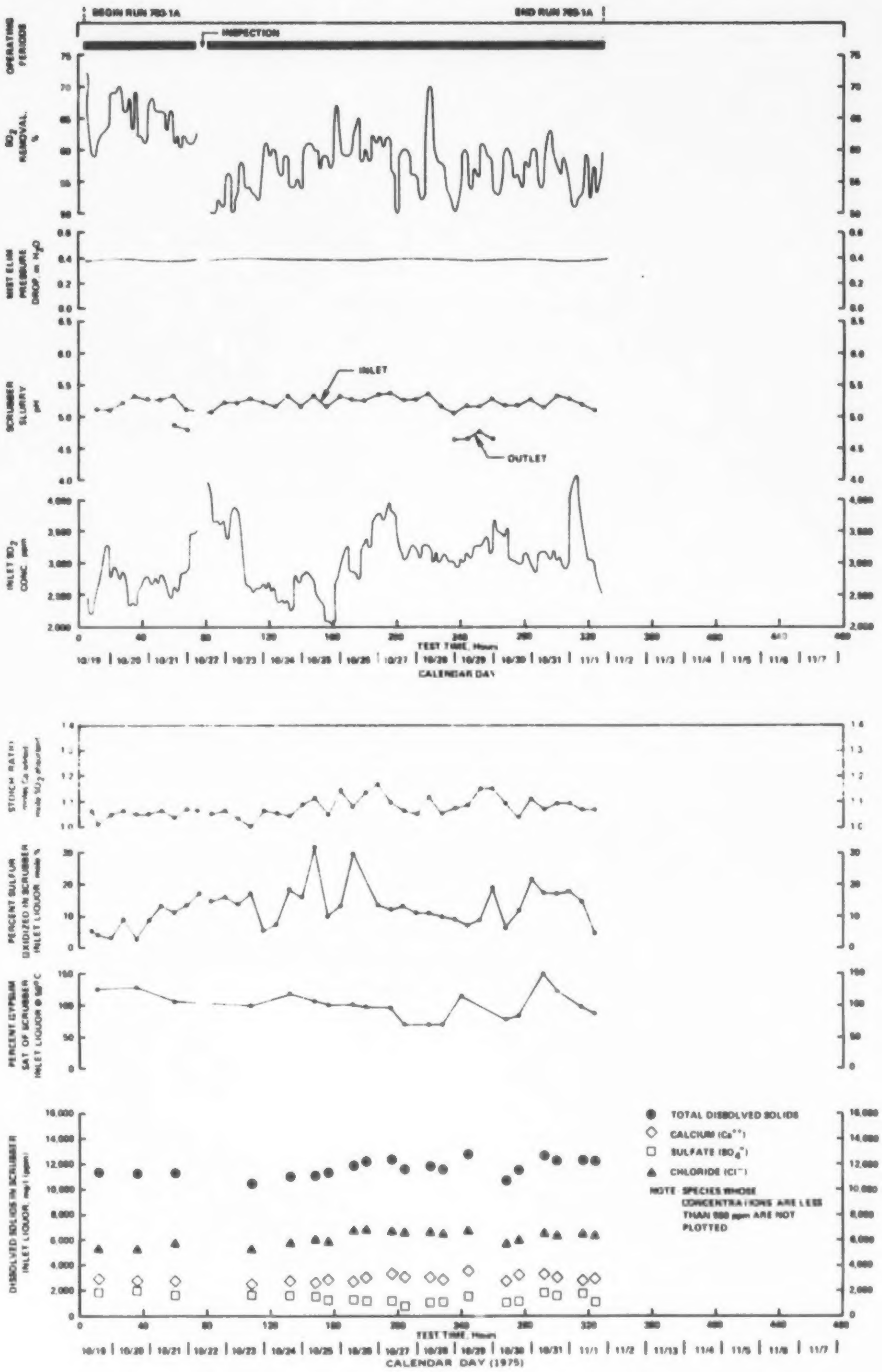
Figure F-7. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 628 - 1B



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower =
1,600 gpm (701-1A), 1,400 gpm (702-1A)
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 57 gal/mcf (701-1A),
50 gal/mcf (702-1A)
No. of Spray Headers = 4
EHT Residence Time = 20 min

Percent Solids Recirculated = 14.4-17 wt % (701-1A),
14.8-15.9 wt % (702-1A)
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.5-15.0 in. H_2O
(701-1A), 13.9-14.6 in. H_2O (702-1A)
Scrubber Inlet Liquor Temperature = 123-128 °F
Liquid Conductivity = 10,000-12,000 μ mhos/cm
Discharge (Clarifier and Filter, 701-1A; Centrifuge, 702-1A)
Solids Concentration = 58-65 wt %
Limestone Addition to EHT

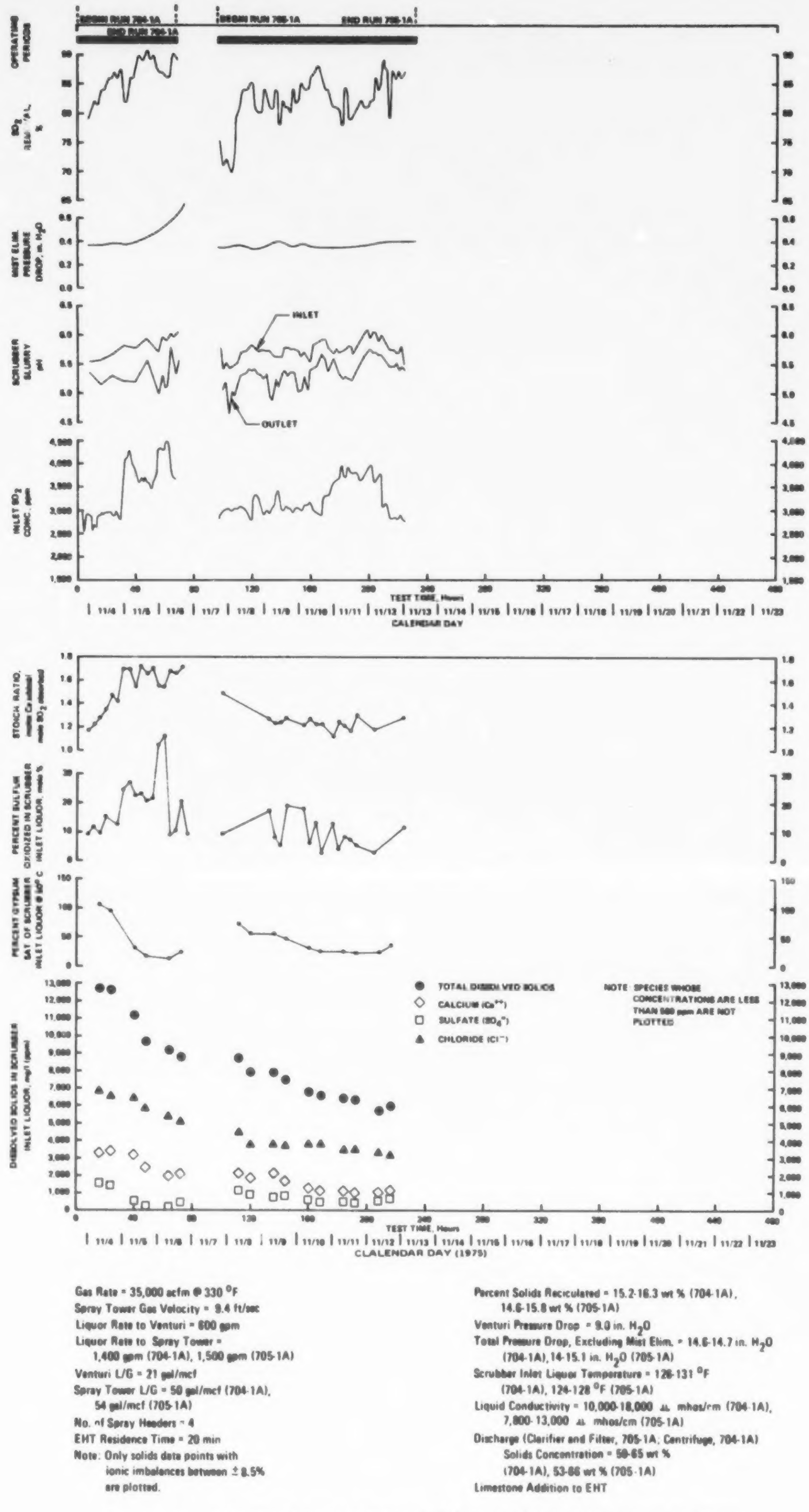
Figure F-8. OPERATING DATA FOR VENTURI/SPRAY TOWER RUNS 701-1A & 702-1A



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 20 min

Percent Solids Recirculated = 14-16 wt %
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.1-15.0 in. H_2O
Scrubber Inlet Liquor Temperature = 126-128 °F
Liquid Conductivity = 11,000-18,400 μ mhos/cm
Discharge (Centrifuge) Solids
Concentration = 60-67 wt %
Limestone Addition to EHT

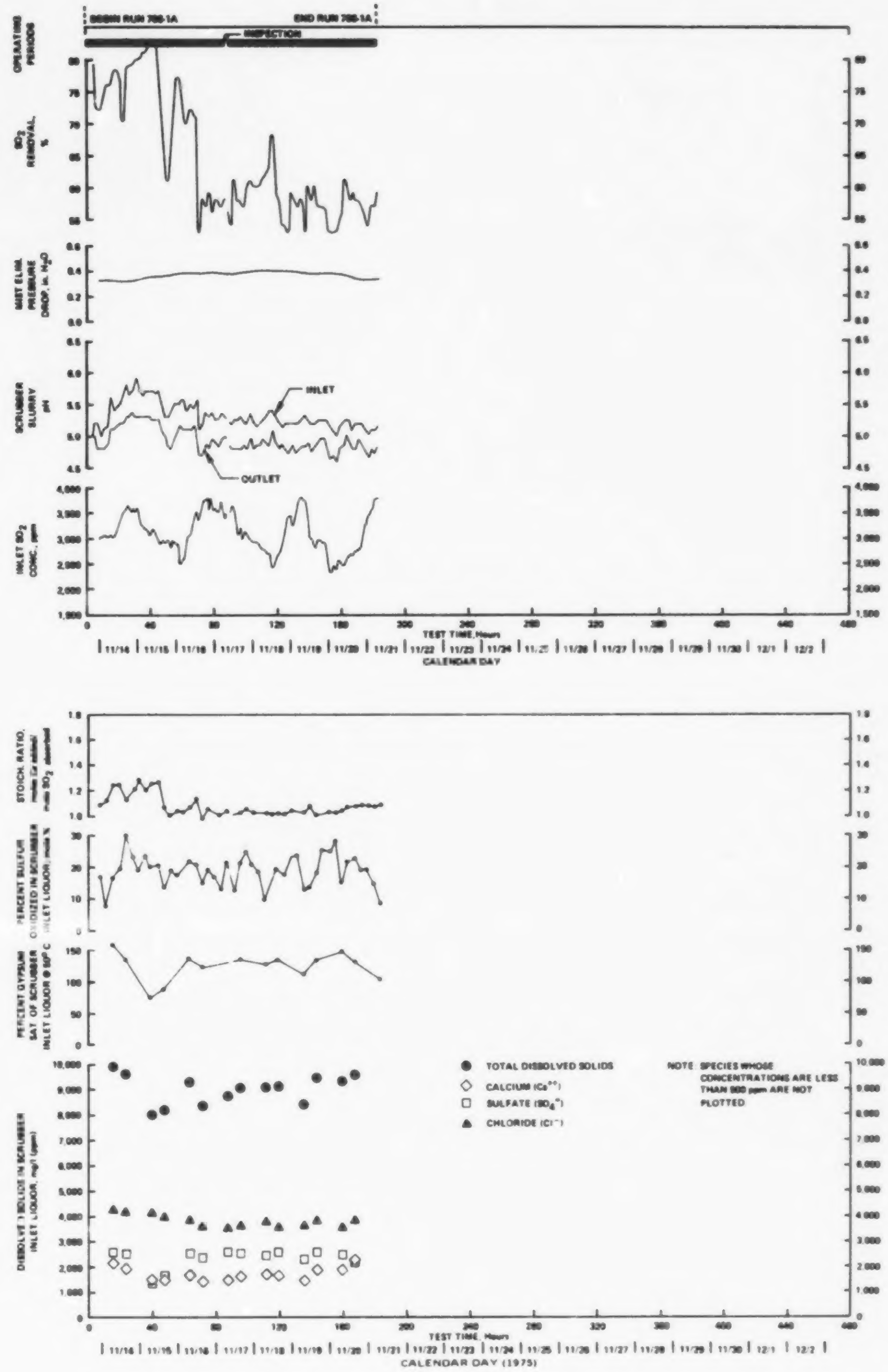
Figure F-9. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 703-1A



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower =
1,400 gpm (704-1A), 1,500 gpm (705-1A)
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf (704-1A),
54 gal/mcf (705-1A)
No. of Spray Headers = 4
EHT Residence Time = 20 min
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

Percent Solids Recirculated = 15.2-16.3 wt % (704-1A),
14.6-15.8 wt % (705-1A)
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.6-14.7 in. H_2O
(704-1A), 14-15.1 in. H_2O (705-1A)
Scrubber Inlet Liquor Temperature = 126-131 °F
(704-1A), 124-128 °F (705-1A)
Liquid Conductivity = 10,000-18,000 μ mhos/cm (704-1A),
7,800-13,000 μ mhos/cm (705-1A)
Discharge (Clarifier and Filter, 705-1A; Centrifuge, 704-1A)
Solids Concentration = 50-65 wt %
(704-1A), 53-66 wt % (705-1A)
Limestone Addition to EHT

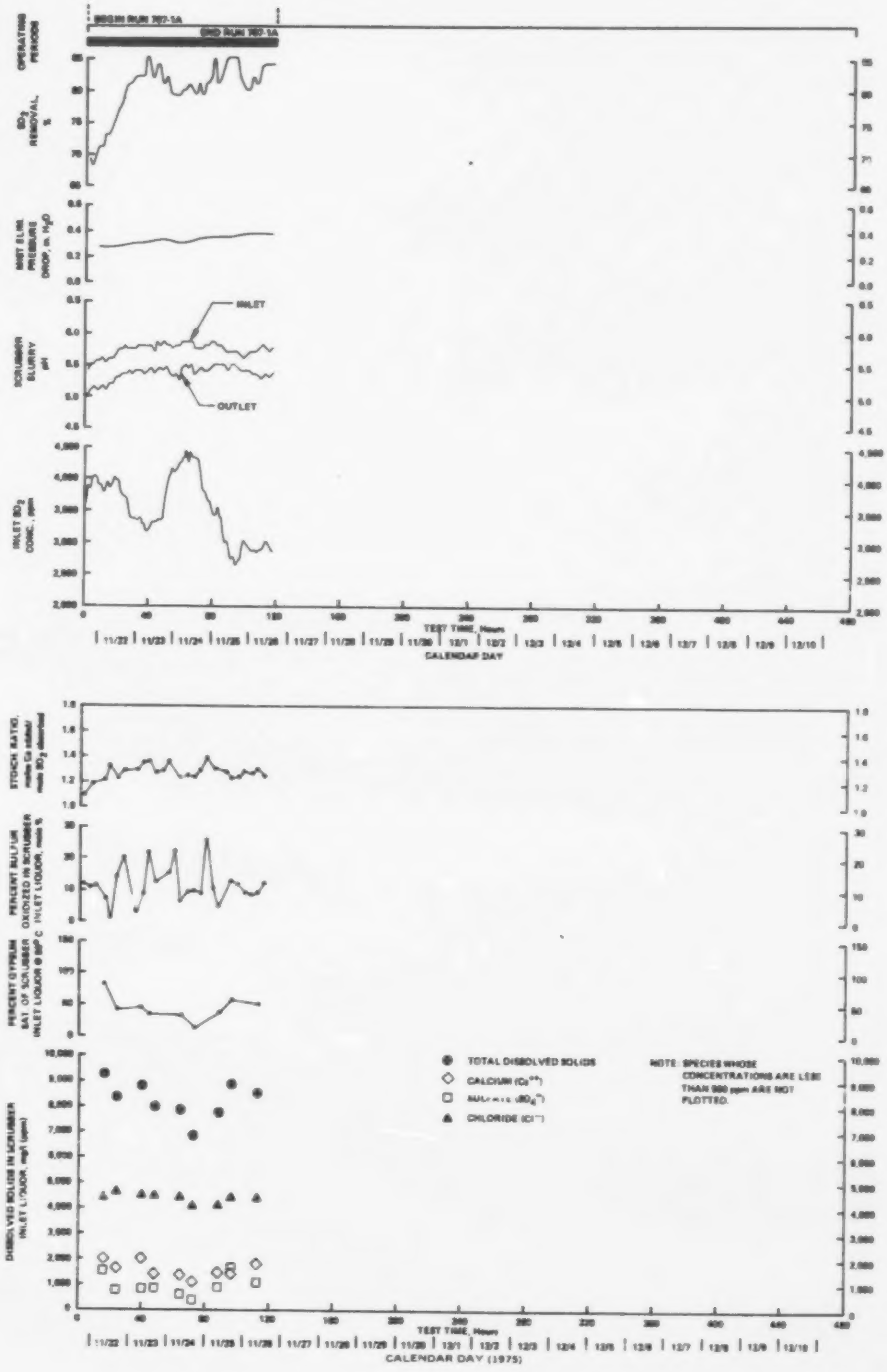
Figure F-10. OPERATING DATA FOR VENTURI/SPRAY TOWER RUNS 704-1A & 705-1A



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min
Note: Only solids data points with ionic imbalances between ± 8.5% are plotted.

Percent Solids Recirculated = 14-15 wt %
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.5-15.2 in. H_2O
Scrubber Inlet Liquor Temperature = 126-128 °F
Liquid Conductivity = 9,700-11,500 μ mhos/cm
Discharge (Centrifuge) Solids Concentration = 54-75 wt %
Limestone Addition to EHT

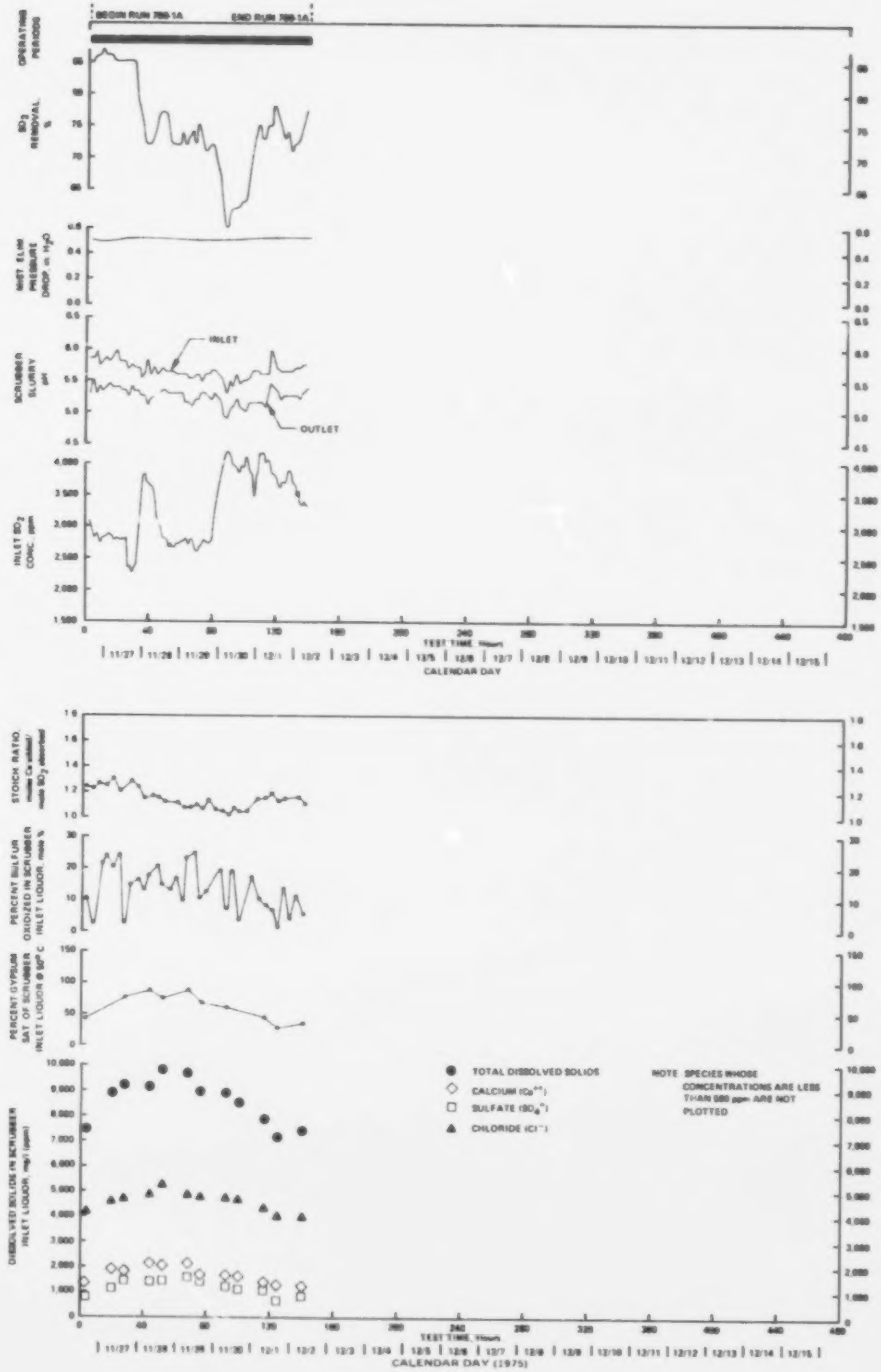
Figure F-11. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 706-1A



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

Percent Solids Recirculated = 14.3-16 wt %
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14-14.9 in. H_2O
Scrubber Inlet Liquor Temperature = 126-129 °F
Liquid Conductivity = 9,000-13,000 μ mhos/cm
Discharge (Centrifuge) Solids
Concentration = 58-73 wt %
Limestone Addition to EHT

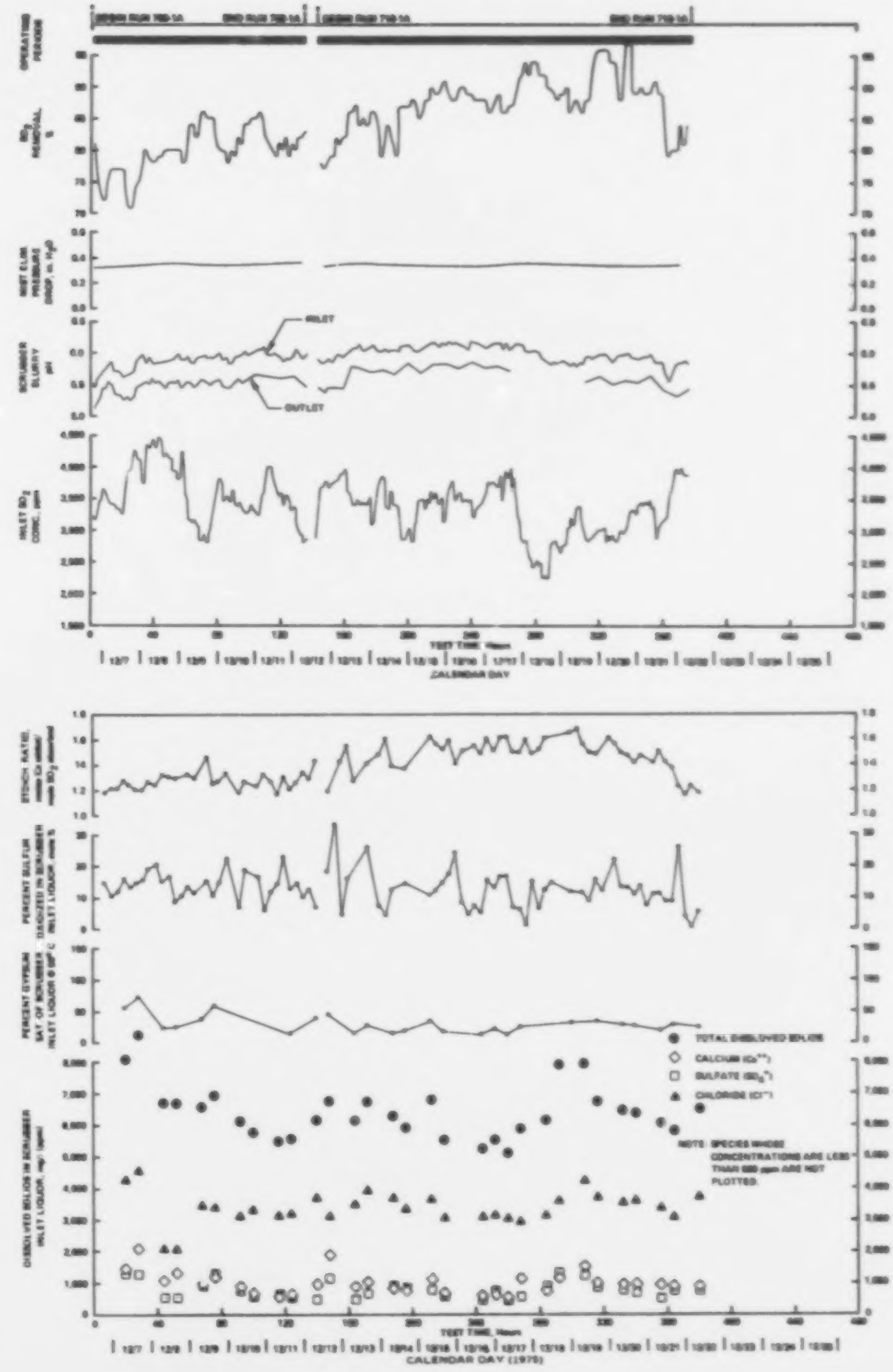
Figure F-12. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 707-1A



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

Percent Solids Recirculated = 14.2-15.4 wt %
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.8-15.2 in. H_2O
Scrubber Inlet Liquor Temperature = 124-129 °F
Liquid Conductivity = 9,500-10,500 μ mhos/cm
Discharge (Centrifuge) Solids
Concentration = 59-65 wt %
Limestone Addition to EHT

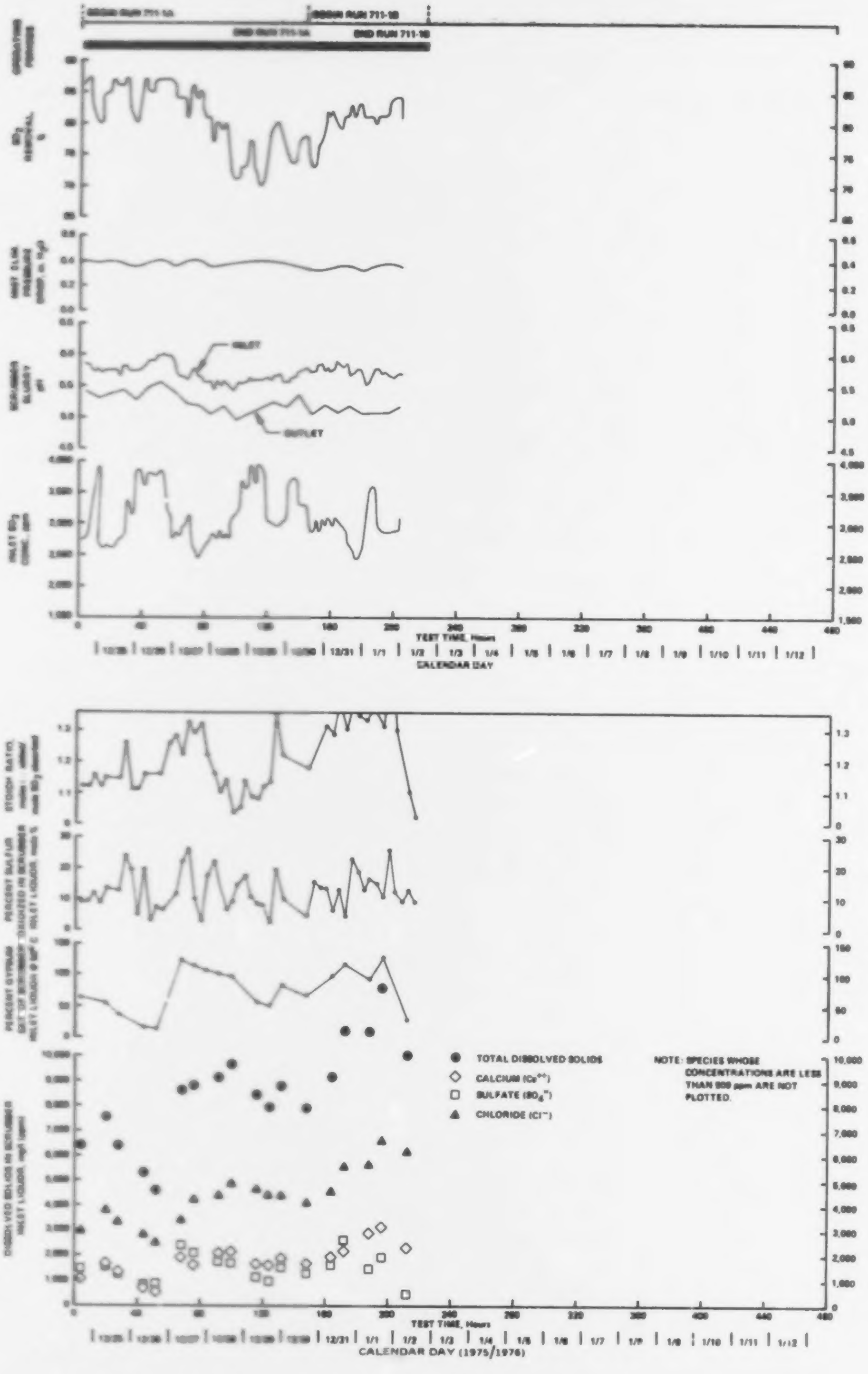
Figure F-13. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 708-1A



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 12 min
Note: Only solids data points with ionic unbalances between ± 8.5% are plotted.

Percent Solids Recirculated = 13.7-14.4 wt % (709-1A), 14-16 wt % (710-1A)
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 13.7-14.6 in. H_2O (709-1A), 14.2-15 in. H_2O (710-1A)
Scrubber Inlet Liquor Temperature = 127-130 °F (709-1A), 128-129 °F (710-1A)
Liquid Conductivity = 7,100-10,400 μ mhos/cm (709-1A), 6,900-9,400 μ mhos/cm (710-1A)
Discharge (Centrifuge) Solids Concentration = 61-65 wt % (709-1A), 57-63 wt % (710-1A)
Limestone Addition to EHT

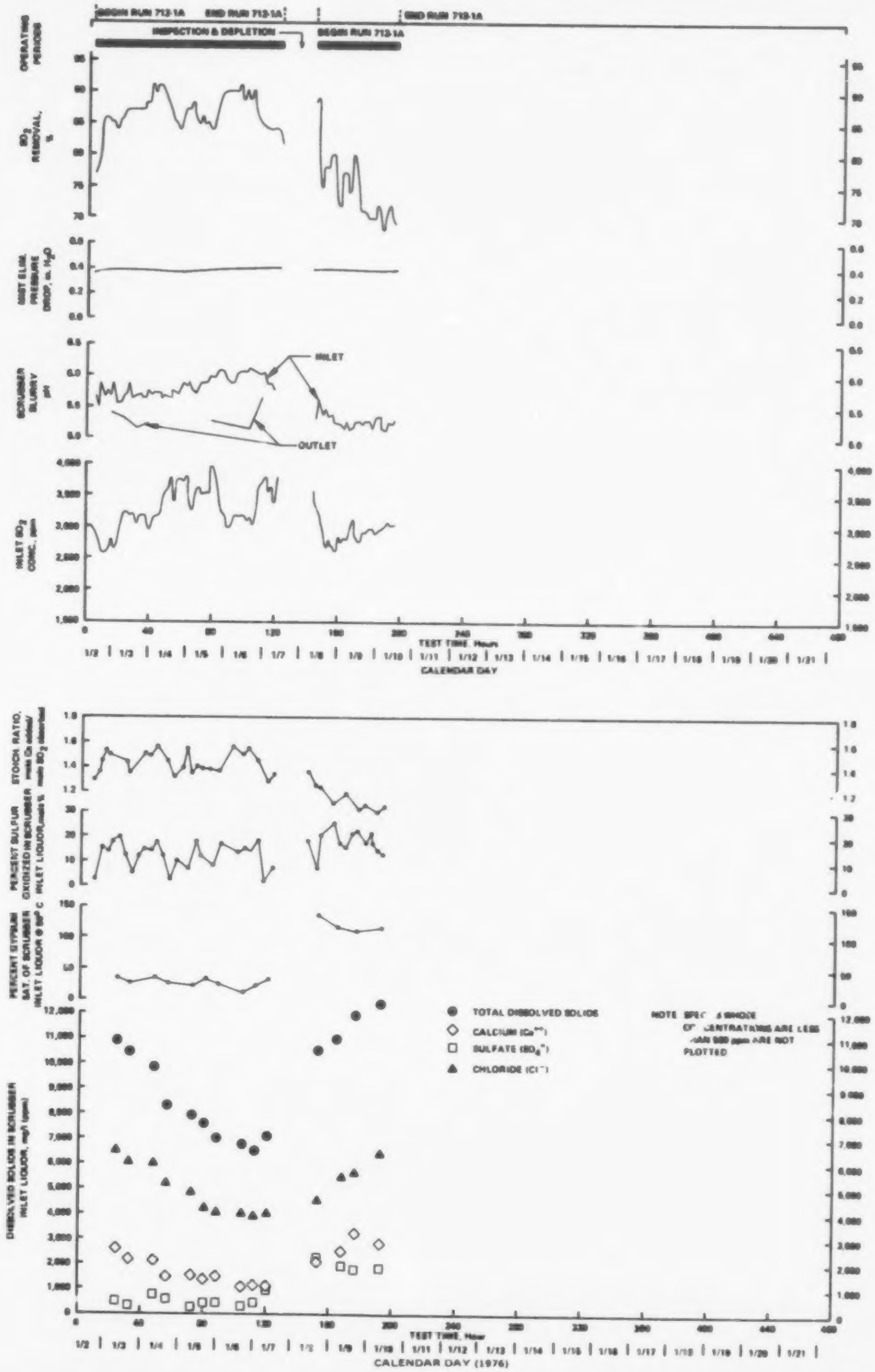
Figure F-14. OPERATING DATA FOR VENTURI/SPRAY TOWER RUNS 709-1A & 710-1A



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 6 min
Note: Only solids data points with
ionic imbalances between ± 6.5%
are plotted

Percent Solids Recirculated = 14.2-15 wt % (711-1A),
14-16 wt % (711-1B)
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.5-15.4 in. H_2O
Scrubber Inlet Liquor Temperature = 126-130 °F (711-1A),
127-129 °F (711-1B)
Liquid Conductivity = 8,400-10,600 μ mhos/cm (711-1A),
9,600-13,500 μ mhos/cm (711-1B)
Discharge (Centrifuge) Solids Concentration =59-65 wt % (711-1A),
56-62 wt % (711-1B)
Limestone Addition to EHT

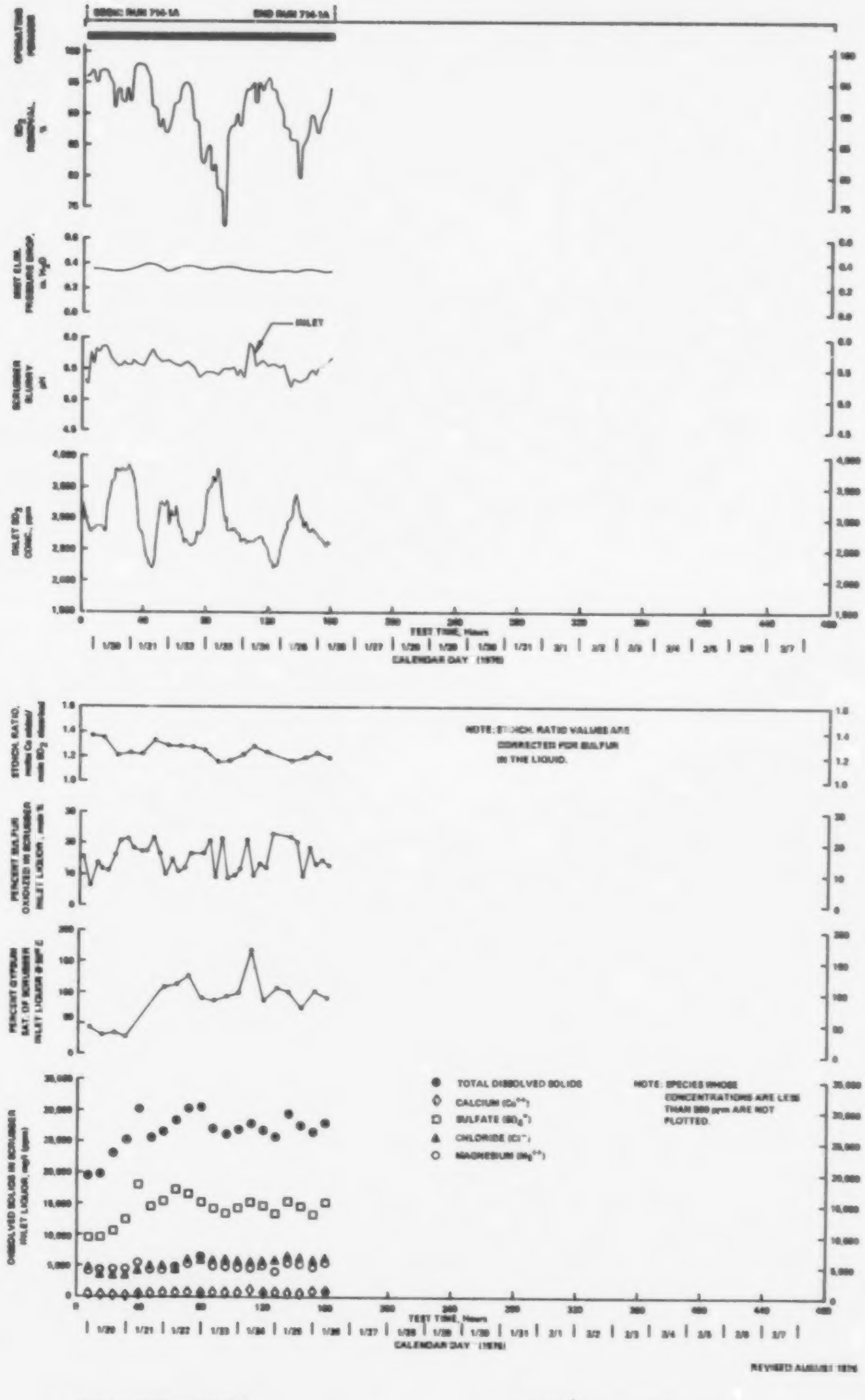
Figure F-15. OPERATING DATA FOR VENTURI/SPRAY TOWER RUNS 711-1A & 711-1B



Gas Rate = 35,000 acfm @ 330 °F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 6 min
Note: Only solids data points with ionic imbalances between ± 8.5% are plotted.

Percent Solids Recirculated = 14.7-15.8 wt % (712-1A), 14-15 wt % (713-1A)
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.6-15.2 in. H_2O (712-1A), 14.3-15.3 in. H_2O (713-1A)
Scrubber Inlet Liquor Temperature = 124-128 °F (712-1A), 127-130 °F (713-1A)
Liquid Conductivity = 8,600-12,800 μ mhos/cm (712-1A), 8,800-12,800 μ mhos/cm (713-1A)
Discharge (Centrifuge) Solids Concentration = 60-63 wt % (712-1A), 59-60 wt % (713-1A)
Limestone Addition to EHT

Figure F-16. OPERATING DATA FOR VENTURI/SPRAY TOWER RUNS 712-1A & 713-1A

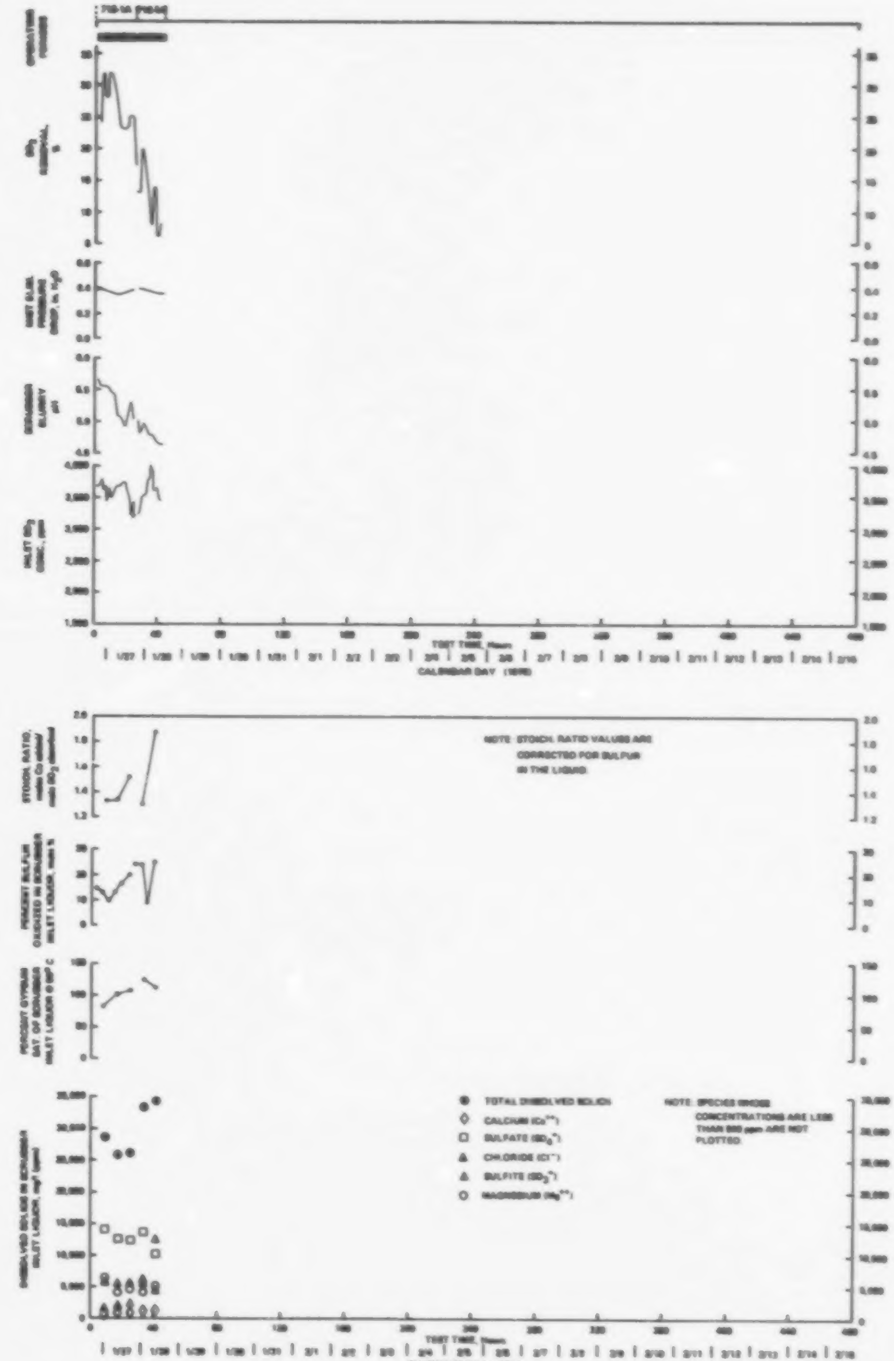


REVISED AUGUST 1976

Gas Rate = 35,000 acfm @ 330° F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 6 min
Note: Only solids data points with ionic imbalances between ± 8.5% are plotted.

Percent Solids Recirculated = 14.5-16 wt %
Venturi Pressure Drop = 9.9 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 14.6-15.6 in. H_2O
Scrubber Inlet Liquor Temperature = 126-130° F
Liquid Conductivity = 18,000-28,000 μ mhos/cm
Discharge (Centrifuge) Solids Concentration = 57-62 wt %
Limestone Addition to EHT

Figure F-17. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 714 - 1A

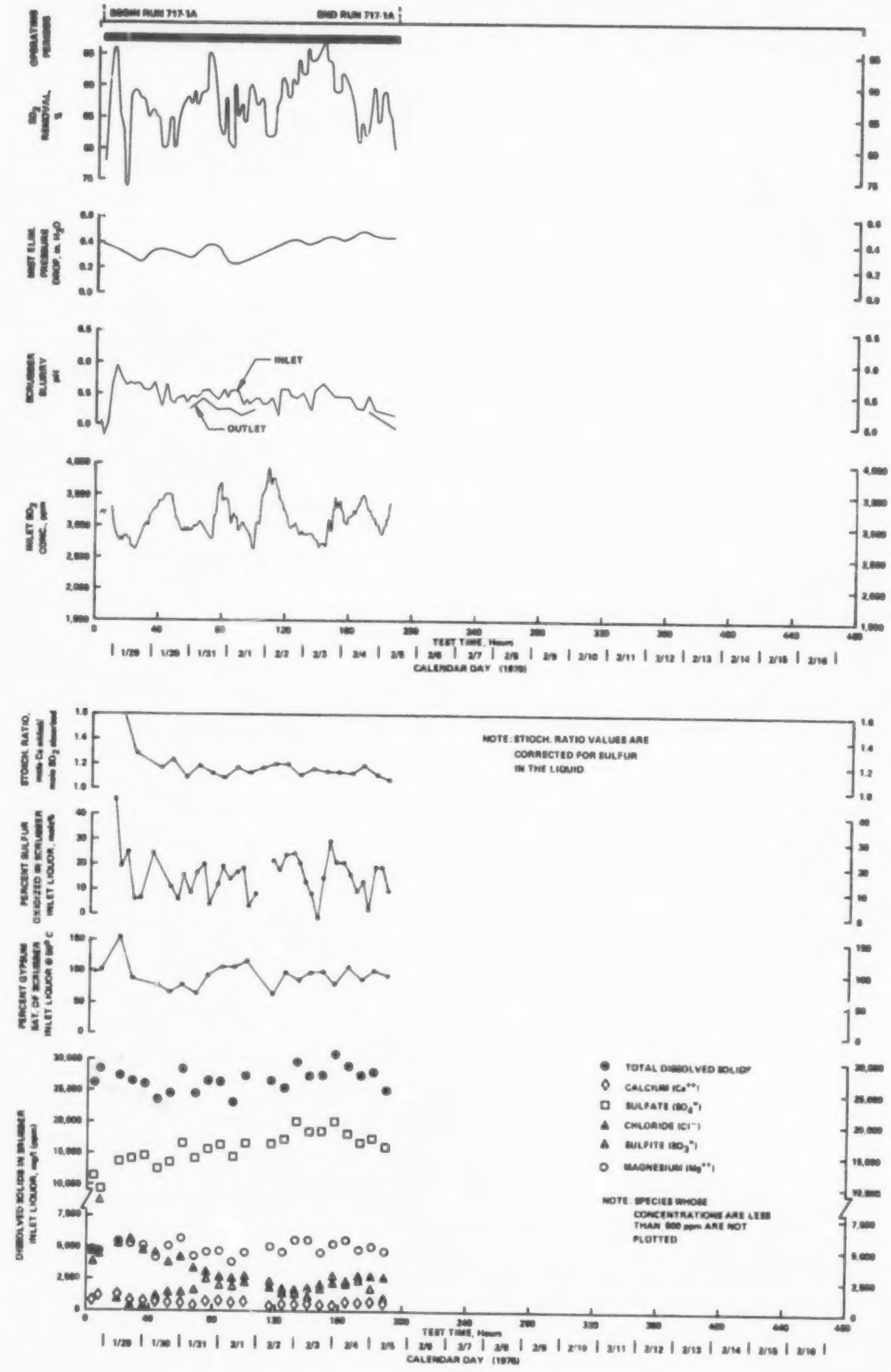


REVISED AUGUST 1976

Gas Rate = 35,000 acfm @ 330° F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi = 600 gpm
Liquor Rate to Spray Tower = 0 gpm
Venturi L/G = 21 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 20 min
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

Percent Solids Recirculated = 14-18 wt % (715-1A),
13-16 wt % (716-1A)
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 13.1-13.9 in. H_2O
(715-1A), 12.9-13.8 in. H_2O (716-1A)
Scrubber Inlet Liquor Temperature = 120-128° F (715-1A)
Liquid Conductivity = 19,000-21,000 μ mhos/cm (715-1A)
Discharge (Centrifuge) Solids Concentration = 56-80 wt %
(715-1A), 70-73 wt % (716-1A)
Limestone Addition to EHT

Figure F-18. OPERATING DATA FOR VENTURI/SPRAY TOWER RUNS 715 - 1A & 716 - 1A



REVISED AUGUST 1976

Gas Rate = 35,000 acfm @ 330° F
Spray Tower Gas Velocity = 9.4 ft/sec
Liquor Rate to Venturi =600 gpm
Liquor Rate to Spray Tower = 1,400 gpm
Venturi L/G = 21 gal/mcf
Spray Tower L/G = 50 gal/mcf
No. of Spray Headers = 4
EHT Residence Time = 6 min
Note: Only solids data points with ionic imbalances between ± 8.5% are plotted.

Percent Solids Recirculated = 14.5-16 wt %
Venturi Pressure Drop = 9.0 in. H_2O
Total Pressure Drop, Excluding Mist Elim. = 13.6-15.6 in. H_2O
Scrubber Inlet Liquor Temperature = 125-131° F
Liquid Conductivity = 17,500-22,000 μ mhos/cm
Discharge (Centrifuge) Solids
Concentration = 53-59 wt %
Limestone Addition to EHT

Figure F-19. OPERATING DATA FOR VENTURI/SPRAY TOWER RUN 717 - 1A

Appendix G

AVERAGE LIQUOR COMPOSITIONS FOR THE VENTURI/SPRAY TOWER TESTS

Table G-1

AVERAGE LIQUOR COMPOSITIONS FOR VENTURI/SPRAY TOWER LIME RUNS FROM JUNE 1975 TO OCTOBER 1975

Run No.	Percent Solids Discharged	Percent Sulfur Oxidized	Sample Point	pH	Liquor Species Concentrations, mg/l (ppm)									Calculated Percent Sulfate Saturation at 50°C[a]
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$SO_3^{=}$	$SO_4^{=}$	$CO_3^{=}$	Cl^{-}	Total	
625-1A	55-60	12-38	Scrubber Inlet	8.15	3300	160	55	130	70	1370	7	5020	10,100	115
			Scrubber Outlet	4.80	3430	150	50	130	490	1760	3	5150	11,200	150
			Clarifier Overflow	8.35	2890	150	60	110	100	1160	10	4430	8900	100
626-1A	52-60	12-32	Scrubber Inlet	8.00	2820	220	65	140	80	1280	14	4790	9400	100
			Scrubber Outlet	4.80	2920	220	60	130	600	1760	5	4540	10,200	140
			Clarifier Overflow	8.20	2340	180	50	110	120	1090	6	3940	7800	85
627-1A	52-56	12-19	Scrubber Inlet	8.05	2640	105	60	125	60	810	7	4390	8200	65
			Scrubber Outlet	5.25	3000	180	70	145	95	1460	35	4930	9900	115
			Clarifier Overflow	8.40	2020	100	70	155	55	640	18	3580	6600	50
78-1A	52-59	10-30	Scrubber Inlet	7.55	1960	270	65	140	70	1440	16	3340	7300	100
			Scrubber Outlet	5.00	2110	260	60	140	390	1990	8	3150	8100	140
			Clarifier Overflow	7.90	1780	245	60	130	60	1260	10	2980	6500	85
628-1B	52-56	14-27	Scrubber Inlet	7.55	2200	280	65	125	45	1210	4	3880	7800	90
			Scrubber Outlet	4.80	2450	285	60	130	450	1780	3	4000	9200	130
			Clarifier Overflow	8.35	1960	250	55	110	60	1060	4	3400	6900	75

Note: The values in this table are averages for the steady-state operating periods.

(a) (activity Ca^{++}) x (activity $SO_4^{=}$)/(solubility product at 50°C). Estimated solubility product for $CaSO_4 \cdot 2H_2O$ at 50°C is 2.2×10^{-5} (Radian Corporation, "A Theoretical Description of the Limestone-Injection Wet Scrubbing Process", NAPCA Report, June 9, 1970).

Table G-2

AVERAGE SCRUBBER INLET LIQUOR COMPOSITIONS FOR VENTURI/SPRAY TOWER LIMESTONE RUNS FROM OCTOBER 1975 TO FEBRUARY 1976

Run No.	Percent Solids Discharged	Percent Sulfur Oxidized	pH	Liquor Species Concentrations, mg/l (ppm)									Calculated Percent Sulfate Saturation at 50°C[(a)]
				Ca^{++}	Mg^{++}	Na^+	K^+	$SO_3^=$	$SO_4^=$	$CO_3^=$	Cl-	Total	
701-1A	58-63	9-22	5.90	2310	420	70	110	40	440	75	4920	8400	30
702-1A	58-65	5-13	5.80	1970	530	60	90	60	405	75	4780	8000	25
703-1A	60-67	4-22	5.20	3040	630	90	115	115	1460	25	6210	11,700	100
704-1A	59-65	10-40	5.75	2850	770	110	120	105	790	95	6200	11,000	55
705-1A	53-66	2-18	5.65	1550	600	75	105	85	730	115	4020	7300	40
706-1A	54-75	9-28	5.30	1800	670	70	115	195	2350	30	3830	9100	125
707-1A	58-73	3-24	5.75	1580	910	75	120	140	950	95	4410	8300	45
708-1A	59-65	1-25	5.65	1650	830	85	115	105	1170	80	4560	8600	55
709-1A	61-65	6-23	5.85	960	760	75	150	85	860	110	3660	6700	30
710-1A	57-63	1-26	6.00	910	780	70	120	80	700	145	3400	6200	25
711-1A	59-65	2-26	5.70	1410	730	65	110	60	1390	110	3740	7600	65
711-1B	56-62	4-22	5.55	2210	690	75	115	90	1460	90	4930	9700	85
712-1A	60-63	3-19	5.80	1610	760	70	125	85	520	100	4940	8200	25
713-1A	59-60	8-25	5.25	2690	910	70	120	95	2100	25	5570	11,600	120
714-1A	57-62	9-21	5.55	620	5000	60	90	1280	14,300	60	5280	26,700	95
715-1A	56-66	9-20	5.30	780	5150	60	105	1960	13,200	15	5710	27,000	110
716-1A	70-73	8-24	4.80	1130	5480	65	95	3870	12,000	4	5340	33,700	120
717-1A	53-59	3-24	5.45	540	4940	65	90	1250	14,300	70	4180	25,500	90

Note: The values in this table are averages for the steady-state operating periods.

(a) (activity Ca^{++}) x (activity $SO_4^=$)/(solubility product at 50°C). Estimated solubility product for $CaSO_4 \cdot 2H_2O$ at 50°C is 2.2×10^{-5} (Radian Corporation, "A Theoretical Description of the Limestone-Injection Wet Scrubbing Process", NAPCA Report, June 9, 1970).

Appendix H

TEST RESULTS SUMMARY TABLE FOR THE TCA

Table H-1

SUMMARY OF LIMESTONE TESTS ON TCA SYSTEM

Run No.	544-2A	545-2A	546-2A	547-2A
Start-of-Run Date	4/4/75	4/15/75	6/8/75	6/18/75
End-of-Run Date	4/15/75	4/21/75	6/17/75	6/23/75
On Stream Hours	269	133	207	112
Gas Rate, acfm @ 300°F	20,500	28,800	30,000	30,000
Gas Velocity, fps @ 125°F	8.6	12.0	12.5	12.5
Liquor Rate, gpm	1200	1000	1000, 1200 (6/12-6/15)	1000
L/G, gal/mcf	73	43	42, 50 (6/12-6/15)	42
Percent Solids Recirculated	12.3-15.0	13.2-14	14-16	13.5-15.9
Effluent Residence Time, min.	15	25	15	15
Stoichiometric Ratio moles Ca added/mole SO_2 absorbed	1.25-1.85	1.20-1.70	1.10-1.30	1.23-1.49
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	65	69	83	73
Inlet SO_2 Concentration, ppm	2500-3875	2400-3800	2600-3500	2500-3500
Percent SO_2 Removal	78-90	77-89	78-89	78-85
Scrubber Inlet pH Range	5.8-6.1	5.8-6.0	5.7-6.0	5.9-6.0
Scrubber Outlet pH Range	5.4-5.6	5.4-5.6	5.3-5.5	5.3-5.5
Percent Sulfur Oxidized	12-40	15-29	10-25	10-16
Solids Disposal System	Clarifier	Clarifier & Filter	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	35-40	~40	35-44	35-43
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	110	90	90	30
Total Dissolved Solids, ppm	5000-8000	4000-8000	4000-7000	3700-4700
Total ΔP Range Excluding Mist Elimination System, in. H_2O	5.0-5.7	6.7-7.0	7.8-9.3	7.3-7.4
Mist Elimination System ΔP Range, in. H_2O	2.0-2.2	2.9-3.0	0.65-0.80	0.65-1.10
Chevron Mist Eliminator ΔP Range, in. H_2O	0.15-0.20	0.40-0.45	Top stage: 0.50-0.55 Btm stage: 0.15-0.25	Top stage: 0.50-0.60 Btm stage: 0.15-0.50
Mist Elimination System Configuration	Koch tray followed by a 6-pass, closed-vane, 316L SS, chevron mist eliminator.	Koch tray followed by a 6-pass, closed-vane, 316 L SS, chevron mist eliminator.	Two 3-pass, closed-vane, FRP chevron mist eliminators in series.	Two 3-pass, closed-vane, FRP chevron mist eliminators in series.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Elimination System Washing Scheme	Bottom of mist elim. washed cont. with 15-19 gpm dil. clar. liq. (~9 gpm makeup water + portion of clar. liq.). K.T. irrig. with remaining clar. liq. + mist elim. wash. Total clar. liq. to mist elim. & K.T. 15 gpm minimum.	Bottom of mist eliminator washed continuously with constant 25 gpm (0.5 gpm/ft^2) dil. clar. liq. (all makeup water plus necessary clarified liquor). Koch tray (2" weir ht.) irrigated with remaining clarified liquor. Clar. return 22 gpm minimum.	Btm. (upstream) m. elim. wash: Top: 75 gpm (1.5 gpm/ft^2) makeup water for constant 10 min, once/4 hrs. Btm: 75 gpm (1.5 gpm/ft^2) makeup water for avg. 7.1 min/hr. Wash cycles staggered. No wash for top stage.	Btm. (upstream) m. elim. wash: Top: 100 gpm (2.0 gpm/ft^2) makeup water for 20 sec, once/10 min. Btm: 100 gpm (2.0 gpm/ft^2) makeup water for avg. 1 min, once/10 min. Wash cycles staggered. No wash for top stage.
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds worn HDPE spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn HDPE spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds new 6 gram TPR spheres.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.
System Changes Before Start-of-Run	Mist eliminator cleaned in place.	No changes.	System cleaned. Installed two new FRP chevron mist eliminators in series. Extended feed well by 6 ft in TCA clarifier. Installed new bloom reheater.	Mist eliminators cleaned in place.
Method of Control	SO_2 removal controlled at 84±2% Overrides: Inlet pH $\leq$6.0 Stoich. Ratio $\leq$1.6	Scrubber outlet pH controlled at 5.4±0.1	Scrubber outlet pH controlled at 5.4±0.1 (5.5±0.1 after 6/13) Overrides: Inlet pH $\leq$6.0 Stoich. Ratio $\leq$1.6	Scrubber outlet pH controlled at 5.5±0.1 Overrides: Inlet pH $\leq$6.0 Stoich. Ratio $\leq$1.6
Run Philosophy	Run required to provide clarifier u'flow for Dravo Corp. sludge fixation tests. Conditions chosen to replicate Run 535-2A to reconfirm mist eliminator performance.	Attempt to determine whether scale formed during Run 539-2A was caused by high scrubber slurry pH (5.9-6.1 inlet, 5.6-5.8 outlet). Conditions identical to Run 539-2A except for method of control.	Observe operability of new two stage mist elimination system at a scrubber gas velocity of 12.5 ft/sec.	Observe operability of two stage mist elimination system with a modified washing scheme.
Results	Run terminated after conclusion of sludge fixation testing. No new solids deposits on mist eliminator since in place cleaning at start of run.	Run terminated prematurely when inspection revealed massive failure of the HDPE spheres (1041 operating hours). No scale on bar grids.	Run terminated due to unsuccessful mist eliminator operation. Bottom mist eliminator stage 30-35% restricted, top stage <5% restricted.	Run terminated due to unsuccessful mist eliminator operation. Bottom mist eliminator stage 30-40% restricted, top stage ~5% restricted.

Table H-1 (continued)

Run No.	548-2A	549-2A	550-2A	551-2A
Start-of-Run Date	6/23/75	6/27/75	7/2/75	7/8/75
End-of-Run Date	6/27/75	7/2/75	7/8/75	7/10/75
On Stream Hours	71	112	119	39
Gas Rate, acfm @ 300°F	30,000	30,000	30,000	30,000
Gas Velocity, fps @ 125°F	12.5	12.5	12.5	12.5
Liquor Rate, gpm	1000	1000	1000	1000
L/G, gal/mcf	42	42	42	42
Percent Solids Recirculated	11-14	12.5-16	14.6-15.7	14.3-14.7
Effluent Residence Time, min.	15	15	15	15
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.35-1.45	1.48-1.60	1.31-1.67	1.4-1.6
Avg % Limestone Utilization, 100x moles SO_2 abs/mole Ca added	71	65	67	66
Inlet SO_2 Concentration, ppm	2000-3000	2200-3100	2400-3000	2700-3100
Percent SO_2 Removal	79-87	74-79	74-78	73-[illegible]
Scrubber Inlet pH Range	5.9-6.1	5.8-6.0	5.6-6.0	5.8-6.0
Scrubber Outlet pH Range	5.4-5.7	5.3-5.5	5.4-5.6	5.5-5.6
Percent Sulfur Oxidized	11-16	12-20	15-21	13-15
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	≅ 22	≅ 30	37-41	39-41
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	35	65	75	20
Total Dissolved Solids, ppm	2000-4500	2000-3100	6000-7000	3900-4300
Total ΔP Range Excluding Mist Elimination System, in. H_2O	6.8-7.2	6.2-6.6	6.1-6.8	6.5-6.6
Mist Elimination System ΔP Range, in. H_2O	0.58-0.65	0.58-0.65	0.66-0.83	0.66-0.80
Chevron Mist Eliminator ΔP Range, in. H_2O	Top stage: 0.45-0.50 Btm stage: 0.13-0.15	Top stage: 0.45-0.50 Btm stage: 0.13-0.15	Top stage: 0.50-0.60 Btm stage: 0.16-0.23	Top stage: 0.50-0.60 Btm stage: 0.16-0.20
Mist Elimination System Configuration	Two 3-pass, closed-vane, FRP chevron mist eliminators in series.	Two 3-pass, closed-vane, FRP chevron mist eliminators in series.	Two 3-pass, closed-vane, FRP chevron mist eliminators in series.	Two 3-pass, closed-vane, FRP chevron mist eliminators in series.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Elimination System Washing Scheme	Btm. (upstream) m. elim. wash: Top: 100 gpm (2.0 gpm/ft^2) makeup water for constant 30 sec, once/10 min Btm: continuous 26 gpm (0.53 gpm/ft^2) makeup water. No wash for top stage. Total water greater than required makeup.	Btm. (upstream) m. elim. wash: Top: 100 gpm (2.0 gpm/ft^2) makeup water for constant 30 sec, once/10 min Btm: continuous 14 gpm (0.29 gpm/ft^2) makeup water. No wash for top stage. Total water greater than required makeup.	Btm. (upstream) m. elim. wash: Top: 100 gpm (2.0 gpm/ft^2) makeup water for constant 30 sec, once/10 min Btm: continuous 16 gpm (0.33 gpm/ft^2). Clarified liquor (≈8 gpm) and makeup water (≈8 gpm). No wash for top stage.	Btm. (upstream) m. elim. wash: Top: 100 gpm (2.0 gpm/ft^2) makeup water for constant 30 sec, once/10 min Btm: continuous 16 gpm (0.33 gpm/ft^2). Clarified liquor (≈8 gpm) and makeup water (≈8 gpm). No wash for top stage.
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.
System Changes Before Start-of-Run	Mist eliminators cleaned in place.	No changes. No cleaning.	Mist eliminators cleaned in place.	Mist eliminators cleaned in place. Replaced 4 underwash nozzles on bottom mist eliminator with a single large nozzle.
Method of Control	Scrubber outlet pH controlled at 5.5±0.1 Overrides: Inlet pH ≤6.0 Stoich. Ratio ≤1.6	Scrubber outlet pH controlled at 5.5±0.1 Overrides: Inlet pH ≤6.0 Stoich. Ratio ≤1.6	Scrubber outlet pH controlled at 5.5±0.1 Overrides: Inlet pH ≤6.0 Stoich. Ratio ≤1.6	Scrubber outlet pH controlled at 5.5±0.1 Overrides: Inlet pH ≤6.0 Stoich. Ratio ≤1.6
Run Philosophy	Observe the operability of the mist elimination system with a continuous raw water bottom stage underwash (system operated open loop).	Observe the operability of the mist elimination system with a reduced rate of bottom stage raw water continuous underwash (system operated open loop).	Observe the operability of the mist elimination system at a gas velocity of 12.5 ft/sec with a bottom wash using diluted clarified liquor.	Observe the operability of the mist elimination system using a single nozzle underwash on the bottom (upstream) mist eliminator.
Results	Run terminated as planned. Inspection revealed bottom stage of mist eliminator 100% clean and top stage 95% clean.	Run terminated when inspection revealed both mist eliminators to be approximately 5% restricted. Restriction appeared to be due to a gap in bottom stage mist eliminator.	Run terminated when inspection revealed the bottom stage mist eliminator to be 15% restricted and the top stage 5-8% restricted with solids.	Run terminated when inspection revealed the bottom stage mist eliminator to be 10-15% restricted and the top stage < 3% restricted with solids.

Table H-1 (continued)

Run No.	552-2A	553-2A	554-2A	555-2A
Start-of-Run Date	7/10/75	7/19/75	7/25/75	7/29/75
End-of-Run Date	7/14/75	7/21/75	7/28/75	8/1/75
On Stream Hours	86	62	68	63
Gas Rate, acfm @ 300°F	30,000	30,000	22,500	22,500
Gas Velocity, fps @ 125°F	12.5	12.5	9.4	9.4
Liquor Rate, gpm	1200	1200	1200	1200
L/G, gal/mcf	50	50	67	67
Percent Solids Recirculated	14.4-15.6	15.5-16.4	14.8-15.0	13.4-13.7
Effluent Residence Time, min.	15	15	15	15
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.42-1.48	1.57	1.58-1.62	1.72
Avg % Limestone Utilization, 100x moles SO_2 abs/mole Ca added	69	64	63	58
Inlet SO_2 Concentration, ppm	3100-3200	2100-2500	2300-3000	2100-2300
Percent SO_2 Removal	79-84	61-83	76-84	77-83
Scrubber Inlet pH Range	5.95-6.02	5.6-6.0	5.95-6.09	5.95
Scrubber Outlet pH Range	5.42-5.60	5.1-5.45	5.45-5.65	5.35
Percent Sulfur Oxidized	13-16	18-26	18-21	15-17
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	38-41	32-37	34-40	≅ 25
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	20	90	55	95
Total Dissolved Solids, ppm	3500-4500	5800-5900	4800-6200	4200-5400
Total ΔP Range Excluding Mist Elimination System, in. H_2O	7.5-7.9	8.5-8.8	5.1-5.3	5.0-5.4
Mist Elimination System ΔP Range, in. H_2O	0.68-0.75	0.31-0.36	0.18-0.40	0.18-0.23
Chevron Mist Eliminator ΔP Range, in. H_2O	Top stage: 0.50-0.55 Btm stage: 0.18-0.20	0.31-0.36	0.18-0.40	0.18-0.23
Mist Elimination System Configuration	Two 3-pass, closed-vane, FRP chevron mist eliminators in series.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Elimination System Washing Scheme	Btm. (upstream) m. elim wash: Top: 100 gpm (2.0 gpm/ft^2) makeup water for constant 30 sec, once/10 min Btm: continuous 22 gpm (0.45 gpm/ft^2). Clarified liquor (≈14 gpm) and makeup water (≈8 gpm). No wash for top stage.	Top washed sequentially with makeup water. Each nozzle (6 total) on 4 min (at 0.55 gpm/ft^2) with 76 min off between nozzles. Bottom washed with makeup water at 2.5 gpm/ft^2 for 5 min every hour.	Top washed sequentially with makeup water. Each nozzle (6 total) on 4 min (at 0.55 gpm/ft^2) with 36 min off between nozzles. Bottom washed with makeup water at 2.5 gpm/ft^2 for 6 min every 2 hours.	Top washed sequentially with makeup water. Each nozzle (6 total) on 4 min (at 0.55 gpm/ft^2) with 36 min off between nozzles. Btm washed cont. with water at 0.4 gpm/ft^2 (open liquor loop).
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.
System Changes Before Start-of-Run	Mist eliminators cleaned in place. Replaced single underwash nozzle on bottom mist eliminator with 4 nozzles.	Installed new 3-pass, open-vane mist eliminator (similar to spray tower mist eliminator).	Mist eliminator cleaned in place.	Mist eliminator cleaned in place.
Method of Control	Scrubber outlet pH controlled at 5.5±0.1. Changed to SO_2 removal control at 84±2% on 7/11. Overrides: Inlet pH ≦ 6.0 Stoich. Ratio ≦ 1.6	SO_2 removal controlled at: 84±2%. Overrides: Inlet pH ≦ 6.0 Stoich. Ratio ≦ 1.6	SO_2 removal controlled at: 84±2%. Overrides: Inlet pH ≦ 6.0 Stoich. Ratio ≦ 1.6	SO_2 removal controlled at: 84±2%. Overrides: Inlet pH ≦ 6.0 Stoich. Ratio ≦ 1.6
Run Philosophy	Observe the operability of the mist elimination system using an increased underwash rate.	Observe the operability of the new mist elimination system at 12.5 ft/sec scrubber gas velocity.	Observe the operability of the mist eliminator at lower (9.4 ft/sec) scrubber gas velocity.	Observe the operability of the mist eliminator with a continuous fresh water bottom wash.
Results	Run terminated when inspection revealed the bottom stage mist eliminator to be 8-10% restricted and the top stage 5% restricted with solids.	Run terminated when inspection revealed the mist eliminator to be 15% restricted with solids.	Run terminated when inspection revealed the mist eliminator to be 50% restricted with solids.	Run terminated as planned. Inspection revealed the mist eliminator to be 9% restricted with solids.

Table H-1 (continued)

Run No.	556-2A	557-2A	558-2A	559-2A
Start-of-Run Date	8/1/75	8/5/75	8/15/75	9/5/75
End-of-Run Date	8/5/75	8/13/75	9/2/75	9/22/75
On Stream Hours	89	181	398	384
Gas Rate, acfm @ 300°F	22,500	30,000	30,000	30,000
Gas Velocity, fps @ 125°F	9.4	12.5	12.5	12.5
Liquor Rate, gpm	1200	1200	1200	1200
L/G, gal/mcf	67	50	50	50
Percent Solids Recirculated	12.9-15.1	14.8-16.2	14.4-15.2	14-16
Effluent Residence Time, min.	15	15	15	15
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.42-1.51	1.08-1.62	1.24-1.45	1.2-1.6
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	68	74	74	71
Inlet SO_2 Concentration, ppm	1900-2700	1500-3000	2200-3200	2000-4100
Percent SO_2 Removal	75-86	80-90	70-81	68-86
Scrubber Inlet pH Range	5.8-6.2	5.8-6.0	5.7-5.95	5.6-6.2
Scrubber Outlet pH Range	5.3-5.7	5.2-5.6	5.2-5.5	5.0-5.8
Percent Sulfur Oxidized	19-29	10-21	10-20	7-24
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	31-49	39-44	34-42	36-42
Calculated Avg. % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	195	70	85	70
Total Dissolved Solids, ppm	5600-6000	4000-6000	3400-6000	3000-6000
Total ΔP Range Excluding Mist Elimination System, in. H_2O	6.8-9.2	7.3-7.5	7.3-7.7	7.0-8.1
Mist Elimination System ΔP Range, in. H_2O	0.16-0.23	0.36-0.44	0.37-0.43	0.38-0.42
Chevron Mist Eliminator ΔP Range, in. H_2O	0.16-0.23	0.36-0.44	0.37-0.43	0.38-0.42
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Elimination System Washing Scheme	Top washed sequentially with makeup water. Each nozzle (6 total) on 4 min (at 0.55 gpm/ft²) with 36 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup water plus necess. clar. liq.) at 0.4 gpm/ft².	Top washed sequentially with makeup water. Each nozzle (6 total) on 4 min (at 0.55 gpm/ft²) with 36 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup water plus necess. clar. liq.) at 0.4 gpm/ft².	Top washed sequentially with makeup wtr. Each noz. (6 total) on 6 min (at 0.55 gpm/ft²) with 24 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr plus necess. clar. liq.) at 0.4 gpm/ft². (N.E. topwash noz. 0.83 gpm/ft² after 8/29).	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N.E. and N.C.) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr plus necess. clar. liq.) at 0.4 gpm/ft².
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.
System Changes Before Start-of-Run	Mist eliminator cleaned. Removed scale test strip under the mist elim. to avoid interference with mist elim. underspray. Removed Collcote test panel under N.E. slurry nozzle to minimize flue gas maldistribution.	Mist eliminator cleaned.	Mist eliminator cleaned.	Mist eliminator and outlet duct cleaned. Streamlined windows. Bottom mist eliminator wash nozzle moved closer to the mist eliminator (from 42" to 36").
Method of Control	SO_2 removal controlled at: 84±2% Overrides: Inlet pH ≤ 6.0 Stoich. Ratio ≤ 1.6	SO_2 removal controlled at: 84±2% Overrides: Inlet pH ≤ 6.0 Stoich. Ratio ≤ 1.6	SO_2 removal controlled at: 84±2% Overrides: Inlet pH ≤ 6.0 Stoich. Ratio ≤ 1.6	SO_2 removal controlled at: 84±2% Overrides: Inlet pH ≤ 6.0 Stoich. Ratio ≤ 1.6
Run Philosophy	Observe mist eliminator operation with a continuous bottom wash using a mixture of makeup water and clarified liquor.	Observe operability of mist eliminator at 12.5 ft/sec scrubber gas velocity with same wash scheme used for Run 556-2A.	Observe operability of mist eliminator at 12.5 ft/sec scrubber gas velocity with increased frequency for top wash.	Observe operability of mist eliminator at 12.5 ft/sec scrubber gas velocity with increased frequency for top wash.
Results	Run terminated when inspection revealed the mist eliminator to be 2% restricted with solids.	Run terminated when inspection revealed the mist eliminator to be 5% restricted with solids.	Run terminated when inspection revealed the mist eliminator to be 12-14% restricted with solids.	Run terminated when inspection revealed mist eliminator to be 7% restricted with solids.

Table H-1 (continued)

Run No.	560-2A	561-2A	562-2A	562-2B
Start-of-Run Date	9/23/75	9/30/75	10/7/75	10/30/75
End-of-Run Date	9/29/75	10/6/75	10/30/75	11/6/75
On Stream Hours	142	135	495	134
Gas Rate, acfm @ 300°F	30,000	30,000	30,000	30,000
Gas Velocity, fps @ 125°F	12.5	12.5	12.5	12.5
Liquor Rate, gpm	1200	1200	1200	1200
L/G, gal/mcf	50	50	50	50
Percent Solids Recirculated	14.6-15	14-16	14-15.5	14-15
Effluent Residence Time, min.	15	15	12	12
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.3-1.7	1.24-1.48	1.2-2.0	1.2-1.6
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	65	74	63	71
Inlet SO_2 concentration, ppm	2800-3800	2000-4000	2000-4000	2500-4000
Percent SO_2 Removal	69-83	70-84	70-90	72-87
Scrubber Inlet pH Range	5.3-6.2	5.7-6.2	5.75-6.05	5.6-5.8
Scrubber Outlet pH Range	4.6-5.6	5.15-5.65	5.2-5.7	5.0-5.3
Percent Sulfur Oxidized	9-17	6-18	5-30	10-30
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	36-41	37-44	37-43	34-46
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	45	55	40	70
Total Dissolved Solids, ppm	3700-4900	3900-6000	4300-7000	5000-8000
Total ΔP Range Excluding Mist Elimination System, in. H_2O	7.0-8.1	7.3-7.6	7.2-7.9	8.0-8.6
Mist Elimination System ΔP Range, in. H_2O	0.35-0.40	0.35-0.40	0.35-0.43	0.35-0.43
Chevron Mist Eliminator ΔP Range, in. H_2O	0.35-0.40	0.35-0.40	0.35-0.43	0.35-0.43
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.
Mist Elimination System Washing Scheme	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and N. C. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft^2.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr plus necess. clar. liq.) at 0.4 gpm/ft^2.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft^2.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft^2.
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.
System Changes Before Start-of-Run	Mist eliminator cleaned. Removed mist eliminator support beams and suspended mist eliminator from top.	Mist eliminator cleaned. East half of mist eliminator rotated 180° horizontally.	Mist eliminator cleaned. Single mist eliminator btm wash nozzle replaced by 2 smaller nozzles.	No changes.
Method of Control	SO_2 removal controlled at: 84±2% Overrides: Inlet pH $\leq$ 6.0 Stoich. Ratio $\leq$ 1.6	SO_2 removal controlled at: 84±2% Overrides: Inlet pH $\leq$ 6.0 Stoich. Ratio $\leq$ 1.6	Scrubber inlet pH controlled at 5.9±0.1.	Stoichiometric ratio controlled at 1.4 moles Ca/mole SO_2 absorbed.
Run Philosophy	Observe operability of mist eliminator at 12.5 ft/sec scrubber gas velocity with mist eliminator T-beams removed and mist eliminator suspended from top.	Observe operability of mist eliminator at 12.5 ft/sec scrubber gas velocity with east half of mist eliminator rotated to eliminate underwash vane shadowing.	First limestone utilization test. Continued mist eliminator testing at 12.5 ft/sec gas velocity.	Attempt to obtain better limestone utilization data by controlling stoichiometric ratio.
Results	Run terminated when inspection revealed the mist eliminator to be 5-7% restricted.	Run terminated when inspection revealed the mist eliminator to be 4-5% restricted.	End of run inspection revealed the mist eliminator to be 7-9% restricted.	End of run inspection revealed the mist eliminator to be 7% restricted.

Table H-1 (continued)

Run No.	563-2A	564-2A	565-2A	566-2A
Start-of-Run Date	11/6/75	11/14/75	11/21/75	11/25/75
End-of-Run Date	11/14/75	11/19/75	11/26/75	12/3/75
On Stream Hours	182	113	109	166
Gas Rate, acfm @ 300°F	30,000	30,000	30,000	30,000
Gas Velocity, fps @ 125°F	12.5	12.5	12.5	12.5
Liquor Rate, gpm	1200	1200	1000	1000
L/G, gal/mcf	50	50	42	42
Percent Solids Recirculated	14.8-15.6	13.4-15	13.8-15.4	13.8-15.5
Effluent Residence Time, min.	12	12	14.4 (3 tanks)	14.4 (3 tanks)
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.3-2.1	1.0-1.1	1.0-1.08	1.1-1.3
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	59	95	96	83
Inlet SO_2 concentration, ppm	2700-3900	2500-4000	2800-4300	2500-4000
Percent SO_2 removal	80-91	46-66	50-64	74-90
Scrubber Inlet pH Range	5.7-6.1	5.0-5.4	5.1-5.3	5.7-6.0
Scrubber Outlet pH Range	5.2-5.9	4.5-4.9	4.4-4.8	5.0-5.4
Percent Sulfur Oxidized	2-23	9-23	5-19	2-25
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	36-46	38-45	34-43	34-44
Calculated Avg % Sulfite Saturation in Scrubber Inlet Liquor @ 50°C	25	120	105	60
Total Dissolved Solids, ppm	3300-5500	5700-7600	4800-7000	4700-6700
Total ΔP Range Excluding Mist Elimination System, in. H_2O	7.8-8.1	7.6-8.2	7.4-8.0	8.7-10.1
Mist Elimination System ΔP Range, in. H_2O	0.40-0.43	0.38-0.45	0.30-0.35	0.30-0.40
Chevron Mist Eliminator ΔP Range, in. H_2O	0.40-0.43	0.38-0.45	0.30-0.35	0.30-0.40
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to EHT.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.
Mist Elimination System Washing Scheme	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft².	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft².	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft².	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft².
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run. 3000 new TPR spheres added to top and middle beds (1500 each) to replace sphere losses.
System Changes Before Start-of-Run	No changes.	No changes.	Three series connected effluent hold tanks installed with limestone makeup to the first tank. Mist eliminator, outlet duct and bottom grid cleaned.	No cleaning. 1500 6 gram TPR spheres added to both top and middle beds.
Method of Control	Stoichiometric ratio controlled at 1.7 moles Ca/mole SO_2 absorbed.	Scrubber inlet pH controlled at 5.2 ± 0.1.	Scrubber inlet pH controlled at 5.2 ± 0.1.	Scrubber inlet pH controlled at 5.9 ± 0.1.
Run Philosophy	Limestone utilization test with 12 min single tank residence time.	Limestone utilization test with 12 min single tank residence time.	Limestone utilization test with 3 tanks in series at a 12 min total residence time.	Limestone utilization test with 3 tanks in series at a 12 min total residence time.
Results	Mist eliminator was 7% restricted at the end of the run, unchanged from the initial restriction. Average limestone utilization was 59% at an average inlet pH of 5.9.	Mist eliminator was 3% restructed at the end of the run, a decrease from the initial 7% restriction. Average limestone utilization was 95% at an average inlet pH of 5.2.	Mist eliminator 0% restricted at end of run. Average limestone utilization was 96% at an average inlet pH of 5.2.	Mist eliminator 0% restricted at end of run. Average limestone utilization was 83% at an average pH of 5.85.

Table H-1 (continued)

Run No.	567-2A	568-2A	569-2A	569-2B
Start-of-Run Date	12/3/75	12/9/75	12/16/75	12/19/75
End-of-Run Date	12/9/75	12/16/75	12/19/75	12/23/75
On Stream Hours	138	162	66	97
Gas Rate, acfm @ 300°F	30,000	30,000	30,000	30,000
Gas Velocity, fps @ 125°F	12.5	12.5	12.5	12.5
Liquor Rate, gpm	1000	1000	1000	1000
L/G, gal/mcf	42	42	42	42
Percent Solids Recirculated	14.7-15.6	14.5-15.3	14.6-15.4	14.8-15.5
Effluent Residence Time, min.	14.4 (3 tanks)	14.4 (3 tanks)	10.8 (3 tanks)	10.2 (3 tanks)
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.2-1.5	0.9-1.1	1.03-1.13	1.06-1.13
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	74	100	93	92
Inlet SO_2 concentration, ppm	2800-3400	2600-3800	3200-4000	3400-3800
Percent SO_2 Removal	79-90	55-70	57-77	57-70
Scrubber Inlet pH Range	5.9-6.1	5.4-5.6	5.4-5.6	5.4-5.6
Scrubber Outlet pH Range	5.3-5.6	4.7-5.0	4.6-4.9	4.9-5.0
Percent Sulfur Oxidized	4-24	7-30	6-23	6-23
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	37-43	38-46	35-46	37-46
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	35	75	115	120
Total Dissolved Solids, ppm	3700-5300	4500-5700	5200-6400	6000-6800
Total ΔP Range Excluding Mist Elimination System, in. H_2O	8.8-9.6	8.6-10.0	7.9-8.9	7.2-8.6
Mist Elimination System ΔP Range, in. H_2O	0.35-0.38	0.33-0.40	0.25-0.35	0.30-0.35
Chevron Mist Eliminator ΔP Range, in. H_2O	0.35-0.38	0.33-0.40	0.25-0.35	0.30-0.35
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.
Mist Elimination System Washing Scheme	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N.E. and S.E. nozzles) with 7 min off between nozzles. Btm washed cont. with dil. clar. liq. (all makeup wtr. plus necess. clar. liq.) at 0.4 gpm/ft².	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N.E. and S.E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft² for 4 min/hr.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N.E. and S.E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft² for 4 min/hr.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N.E. and S.E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft² for 4 min/hr.
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds worn TPR spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds new 6.5 gram nitrile foam spheres (22,500 total).
System Changes Before Start-of-Run	No changes.	Changed from continuous to intermittent M.E. bottom wash.	No changes.	Installed three beds of 6.5 gram nitrile foam spheres. No cleaning.
Method of Control.	Stoichiometric ratio controlled at 1.4 moles Ca/mole SO_2 absorbed.	Scrubber inlet pH controlled at 5.5±0.1.	Scrubber inlet pH controlled at 5.5±0.1.	Scrubber inlet pH controlled at 5.5±0.1.
Run Philosophy	Limestone utilization test with 3 tanks in series at a 12 min total residence time.	Limestone utilization test with 3 tanks in series at a 12 min total residence time. Mist eliminator wash scheme modified.	Limestone utilization test with 3 tanks in series at a 9 min total residence time.	Limestone utilization test with 3 tanks in series at a 9 min total residence time using new nitrile foam spheres.
Results	Mist eliminator 3% restricted at end of run, an increase from the initial 0% restriction. Average limestone utilization was 74% at an average inlet pH of 6.0.	Mist eliminator 1% restricted at end of run. Average limestone utilization was 100% at an average inlet of 5.5.	Mist eliminator was < 1% restricted at the end of run. Average limestone utilization was 93% at an average inlet pH of 5.5.	Mist eliminator was < 1% restricted at end of run. Average limestone utilization was 92% at an average inlet pH of 5.5.

Table H-1 (continued)

Run No.	570-2A	571-2A	572-2A	573-2A
Start-of-Run Date	12/23/75	12/29/75	1/2/76	1/9/76
End-of-Run Date	12/29/75	1/2/76	1/9/76	1/11/76
On Stream Hours	144	96	154	45
Gas Rate, acfm @ 300°F	30,000	30,000	30,000	30,000
Gas Velocity, fps @ 125°F	12.5	12.5	12.5	12.5
Liquor Rate, gpm	1000	1000	1000	1000
L/G, gal/mcf	42	42	42	42
Percent Solids Recirculated	13.8-15.4	14.2-15.8	14-15	14.5-15.5
Effluent Residence Time, min.	10.8 (3 tanks)	10.8 (3 tanks)	10.8 (3 tanks)	14.4 (3 tanks)
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.1-1.2	1.2-1.4	1.02-1.20	1.0-1.2
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	87	77	90	91
Inlet SO_2 concentration, ppm	2300-3700	2100-3700	2500-3800	2600-2900
Percent SO_2 Removal	65-79	65-82	48-62	57-69
Scrubber Inlet pH Range	5.65-5.85	5.7-6.0	5.05-5.4	5.35-5.65
Scrubber Outlet pH Range	4.9-5.2	5.0-5.3	4.55-4.9	-
Percent Sulfur Oxidized	5-25	3-23	10-29	6-28
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	34-41	34-42	34-47	34-43
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	115	130	110	80
Total Dissolved Solids, ppm	6000-8000	7000-8000	6300-8100	8700-9300
Total ΔP Range Excluding Mist Elimination System, in. H_2O	6.9-8.1	6.7-7.3	6.3-7.1	6.7-7.1
Mist Elimination System ΔP Range, in. H_2O	0.30-0.35	0.33-0.35	0.30-0.40	0.30-0.35
Chevron Mist Eliminator ΔP Range, in. H_2O	0.30-0.35	0.33-0.35	0.30-0.40	0.30-0.35
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.	Limestone slurried to 60 wt % with clarified process liquor and added to first tank in series.
Mist Elimination System Washing Scheme	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.	No top wash. Bottom washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds nitrile foam spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds nitrile foam spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds nitrile foam spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds nitrile foam spheres from previous run.
System Changes Before Start-of-Run	No changes.	No changes.	No changes.	No changes.
Method of Control	Stoichiometric ratio controlled at 1.15 moles Ca/mole SO_2 absorbed.	Stoichiometric ratio controlled at 1.3 moles Ca/mole SO_2 absorbed.	Scrubber inlet pH controlled at 5.2±0.1.	Scrubber inlet pH controlled at 5.5±0.1.
Run Philosophy	Limestone utilization test with 3 tanks in series at a 9 min total residence time.	Limestone utilization test with 3 tanks in series at a 9 min total residence time.	Limestone utilization test with 3 tanks in series at a 9 min total residence time.	Rerun of 568-2A due to analytical difficulties encountered during 568-2A.
Results	Mist eliminator was < 1% restricted at end of run. Average limestone utilization was 87% at an average inlet pH of 5.75.	Mist eliminator was < 1% restricted at end of run. Average limestone utilization was 77% at an average inlet pH of 5.85.	Average limestone utilization was 90% at an average inlet pH of 5.23.	Run terminated when unit 10 shut down with a tube leak. Mist eliminator was < 1% restricted at end of run. Average limestone utilization was 91% at an average inlet pH of 5.5.

Table H-1 (continued)

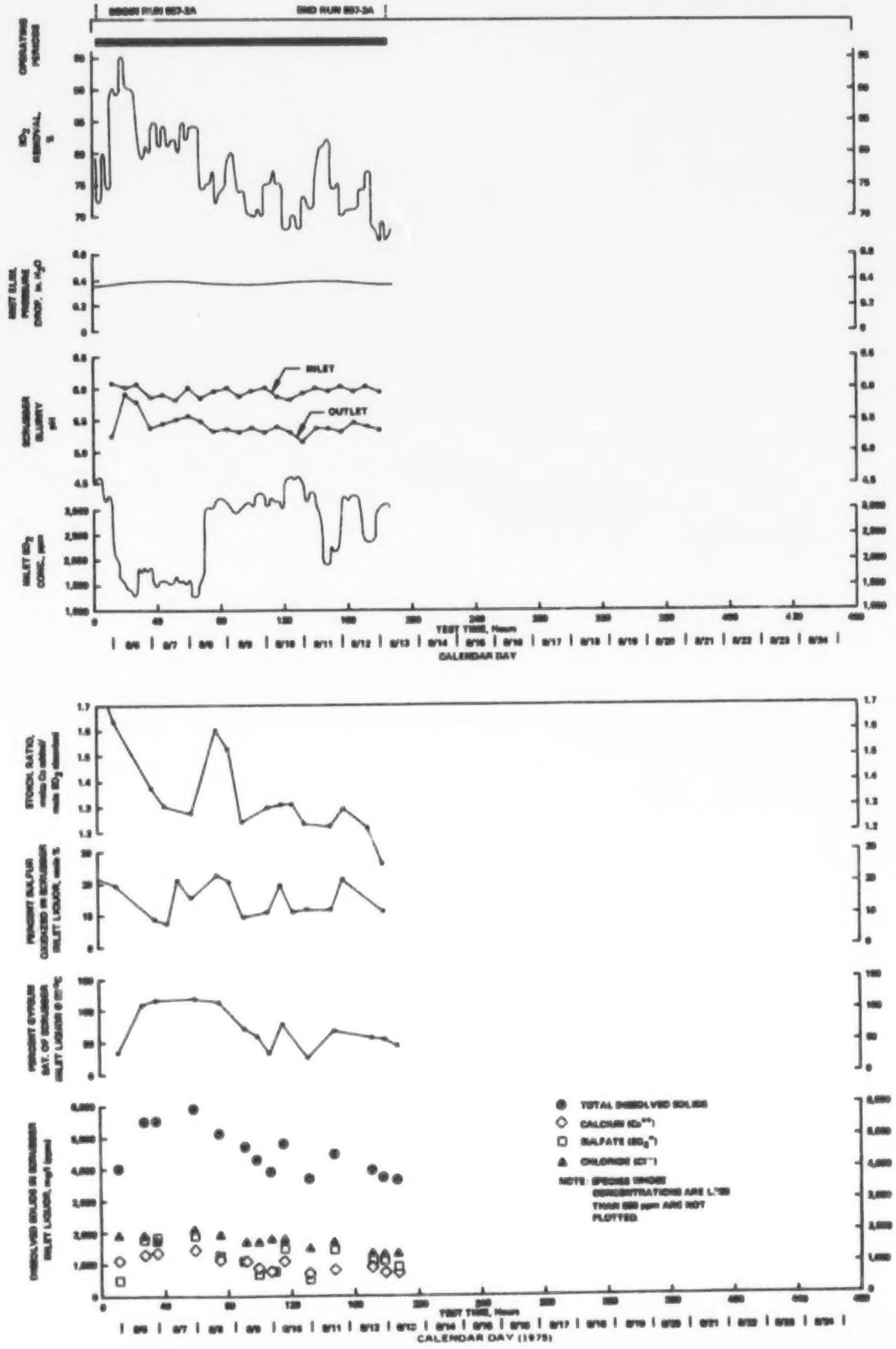
Run No.	575-2A	576-2A	577-2A	578-2A
Start-of-Run Date	1/15/76	1/17/76	1/22/76	1/29/76
End-of-Run Date	1/17/76	1/22/76	1/29/76	2/1/76
On Stream Hours	47	112	159	62
Gas Rate, acfm @ 300°F	30,000	30,000	30,000	30,000
Gas Velocity, fps @ 125°F	12.5	12.5	12.5	12.5
Liquor Rate, gpm	1000	1000	1000	1000
L/G, gal/mcf	42	42	42	42
Percent Solids Recirculated	14-15.5	14.8-15.5	14-15.5	14.5-15.3
Effluent Residence Time, min.	14.4 (3 tanks)	14.4 (3 tanks)	14.4 (3 tanks)	10.8 (3 tanks)
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.02-1.2	1.02-1.25	1.15-1.35	1.0-1.06
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	90	88	80	97
Inlet SO_2 concentration, ppm	2600-3600	2500-4000	2800-3800	2500-3900
Percent SO_2 Removal	62-78	65-79	77-87	53-68
Scrubber Inlet pH Range	5.35-5.55	5.5-5.8	5.65-5.9	5.1-5.3
Scrubber Outlet pH Range	4.55-4.85	4.75-5.2	5.1-5.35	4.4-5.0
Percent Sulfur Oxidized	6-23	6-23	5-20	12-28
Solids Disposal System	Clarifier	Clarifier	Clarifier	Clarifier
Loop Closure, % Solids, Dischg.	35-39	37-42	39-43	40-45
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	105	55	70	120
Total Dissolved Solids, ppm	7300-9000	7000-9300	6300-8300	7000-8200
Total ΔP Range Excluding Mist Elimination System, in. H_2O	6.1-7.2	7.1-7.9	8.0-9.6	9.3-10.1
Mist Elimination System ΔP Range, in. H_2O	0.30-0.38	0.35-0.40	0.35-0.41	0.45-0.55
Chevron Mist Eliminator ΔP Range, in. H_2O	0.30-0.38	0.35-0.40	0.35-0.41	0.45-0.55
Mist Elimination System Configuration	3-pass, open-vane 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.	3-pass, open-vane, 316L SS, chevron mist eliminator.
Absorbent	Limestone slurried to 60 wt % with makeup water and added to first tank in series.	Limestone slurried to 60 wt % with makeup water and added to first tank in series.	Limestone slurried to 60 wt % with makeup water and added to first tank in series.	Limestone slurried to 60 wt % with makeup water and added to first tank in series.
Mist Elimination System Washing Scheme	No top wash. Bottom washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.	No top wash. Bottom washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.	Top washed sequentially with makeup wtr. Each noz.(6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft^2, 0.83 gpm/ft^2 for N. E. and S. E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft^2 for 4 min/hr.
Scrubber Internals	3 stages (4 grids) with 5 inches spheres/stage. All beds nitrile form spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds nitrile foam spheres from previous run.	3 stages (4 grids) with 5 inches spheres/stage. All beds with used nitrile foam spheres from previous run plus 2500/bed new nitrile foam spheres.	3 stages (4 grids) with 5 inches spheres/stage. All beds nitrile foam spheres from previous run.
System Changes Before Start-of-Run	Mist eliminator cleaned.	No changes.	Mist eliminator cleaned.	No changes.
Method of Control	Scrubber inlet pH controlled at 5.5±0.1.	Scrubber inlet pH controlled at 5.7±0.1.	Stoichiometric ratio controlled at 1.25 moles Ca/mole SO_2 absorbed.	Scrubber inlet pH controlled at 5.2±0.1.
Run Philosophy	Limestone utilization test with 3 tanks in series at a 12 min total residence time.	Limestone utilization test with 3 tanks in series at a 12 min total residence time.	Run conditions choosen similar to those for 571-2A except for 12 min residence time to duplicate good mist eliminator performance during 571-2A at a satisfactory SO_2 removal level.	Limestone utilization test with 3 tanks in series at a 9 min total residence time. (Same as 572-2A except for no. spheres/bed.)
Results	Average limestone utilization 90% at an average inlet pH of 5.45.	Average limestone utilization was 88% at an average inlet pH of 5.65.	Mist eliminator was 20% restricted, possibly due to under wash header valve leakage.	Average limestone utilization was 97% at an average inlet pH of 5.2.

Table H-1 (continued)

Run No.	581-2A	
Start-of-Run Date	2/4/76	
End-of-Run Date	2/11/76	
On Stream Hours	164	
Gas Rate, acfm @ 300°F	27,500-30,000	
Gas Velocity, fps @ 125°F	11.5-12.5	
Liquor Rate, gpm	1200	
L/G, gal/mcf	50-54	
Percent Solids Recirculated	14-15.5	
Effluent Residence Time, min.	12	
Stoichiometric Ratio, moles Ca added/mole SO_2 absorbed	1.0-1.3	
Avg % Limestone Utilization, 100x moles SO_2 abs./mole Ca added	87	
Inlet SO_2 concentration, ppm	2000-3500	
Percent SO_2 Removal	73-96	
Scrubber Inlet pH Range	5.2-5.7	
Scrubber Outlet pH Range	4.8-5.3	
Percent Sulfur Oxidized	18-40	
Solids Disposal System	Clarifier	
Loop Closure, % Solids, Dischg.	35-42	
Calculated Avg % Sulfate Saturation in Scrubber Inlet Liquor @ 50°C	125	
Total Dissolved Solids, ppm	7,000-10,000	
Total ΔP Range Excluding Mist Elimination System, in. H_2O	8.7-14.4	
Mist Elimination System ΔP Range, in. H_2O	0.28-0.35	
Chevron Mist Eliminator ΔP Range, in. H_2O	0.28-0.35	
Mist Elimination System Configuration	3-pass, open-vane, 316L SS, chevron mist eliminator.	
Absorbent	Limestone slurried to 60 wt % with makeup water and added to first tank to series.	
Mist Elimination System Washing Scheme	Top washed sequentially with makeup wtr. Each noz. (6 total) on 3 min (at 0.55 gpm/ft², 0.83 gpm/ft² for N.E. and S.E. nozzles) with 7 min off between nozzles. Btm washed with makeup water at 1.5 gpm/ft² for 4 min/hr.	
Scrubber Internals	3 stages (4 grids) with 10,000 spheres/stage (about 8 inches/stage). All beds new 6.5 gram nitrile foam spheres.	
System Changes Before Start-of-Run	No changes.	
Method of Control	Stoichiometric ratio controlled at 1.10 moles Ca/mole SO_2 absorbed.	
Run Philosophy	Limestone utilization test with one tank at 12 min residence time. Also to condition new beds of foam spheres to stabilize sphere shrinkage before factorial testing.	
Results	Average limestone utilization was 87% at an average inlet pH of 5.5. SO_2 removal was high due to a flooded bed.	

Appendix I

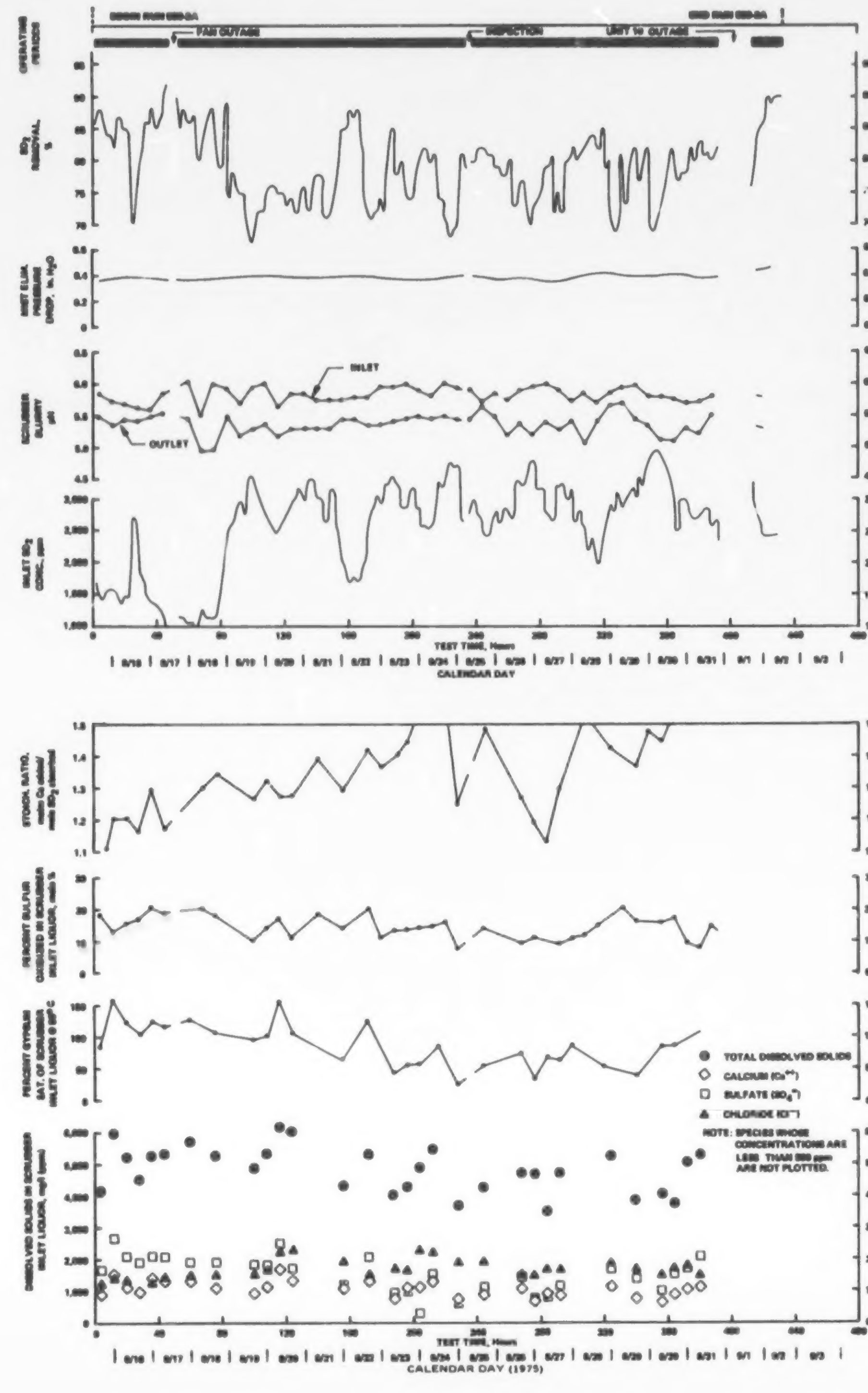
GRAPHICAL OPERATING DATA FROM THE TCA TESTS



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 15 min
Three Stages, 5 in spheres/stage

Percent Solids Recirculated = 14.8-16.2 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.3-7.5 in. H_2O
Scrubber Inlet Liquor Temperature = 126-128 °F
Liquid Conductivity = 4,300-5,300 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 38-44 wt %
Limestone Addition to EHT

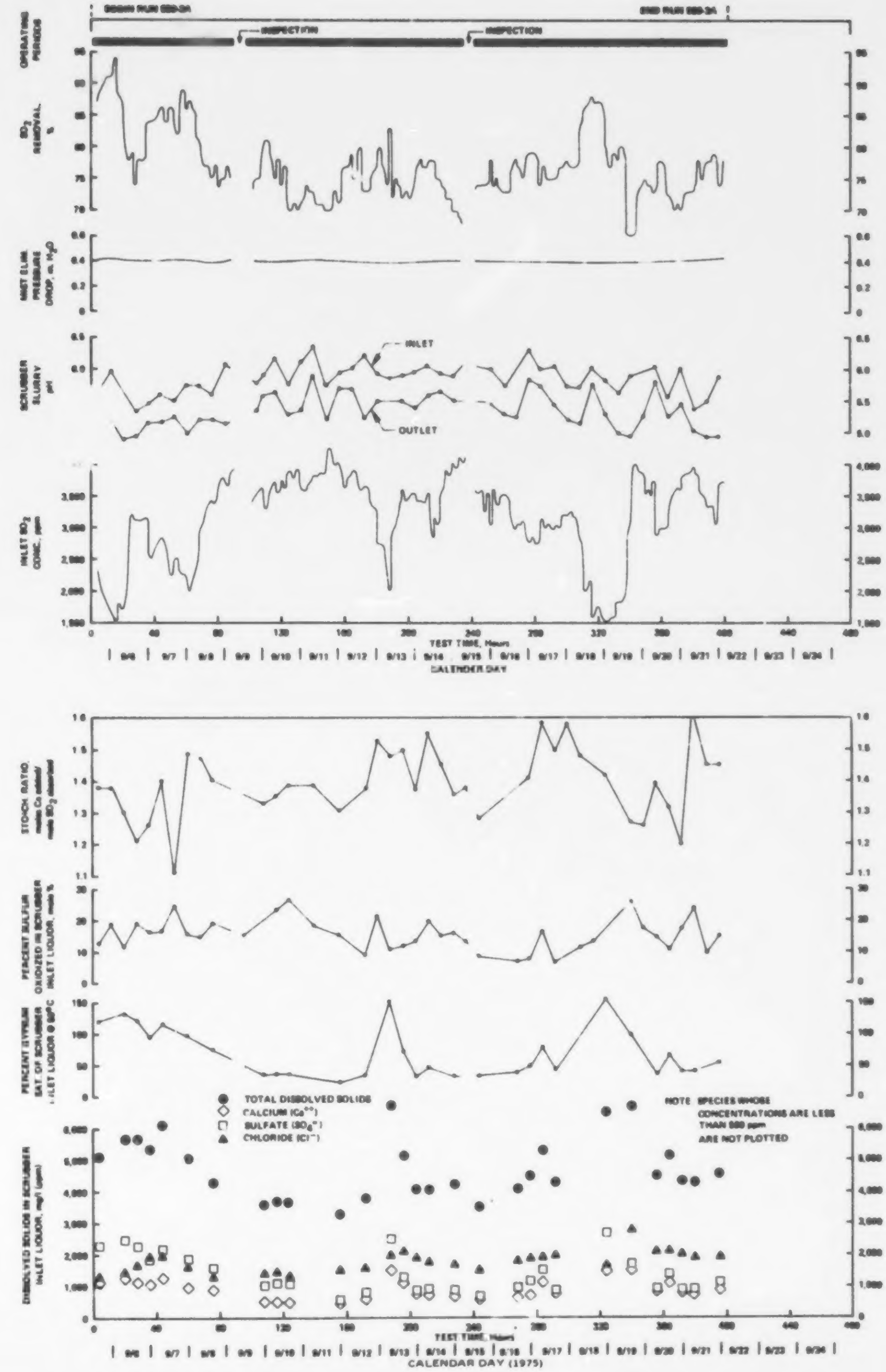
Figure I- 1 OPERATING DATA FOR TCA RUN 557-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1250 gpm
L/G = 50 gal/mcf
EHT Residence Time = 15 min
Three Stages, 5 in. sphere/stage

Percent Solids Recirculated = 14.4-15.2 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.3-7.7 in. H_2O
Scrubber Inlet Liquor Temperature = 126-130 °F
Liquid Conductivity = 4,100-5,700 µ mhos/cm
Discharge (Clarifier) Solids
Concentration = 34-42 wt %
Limestone Addition to EHT

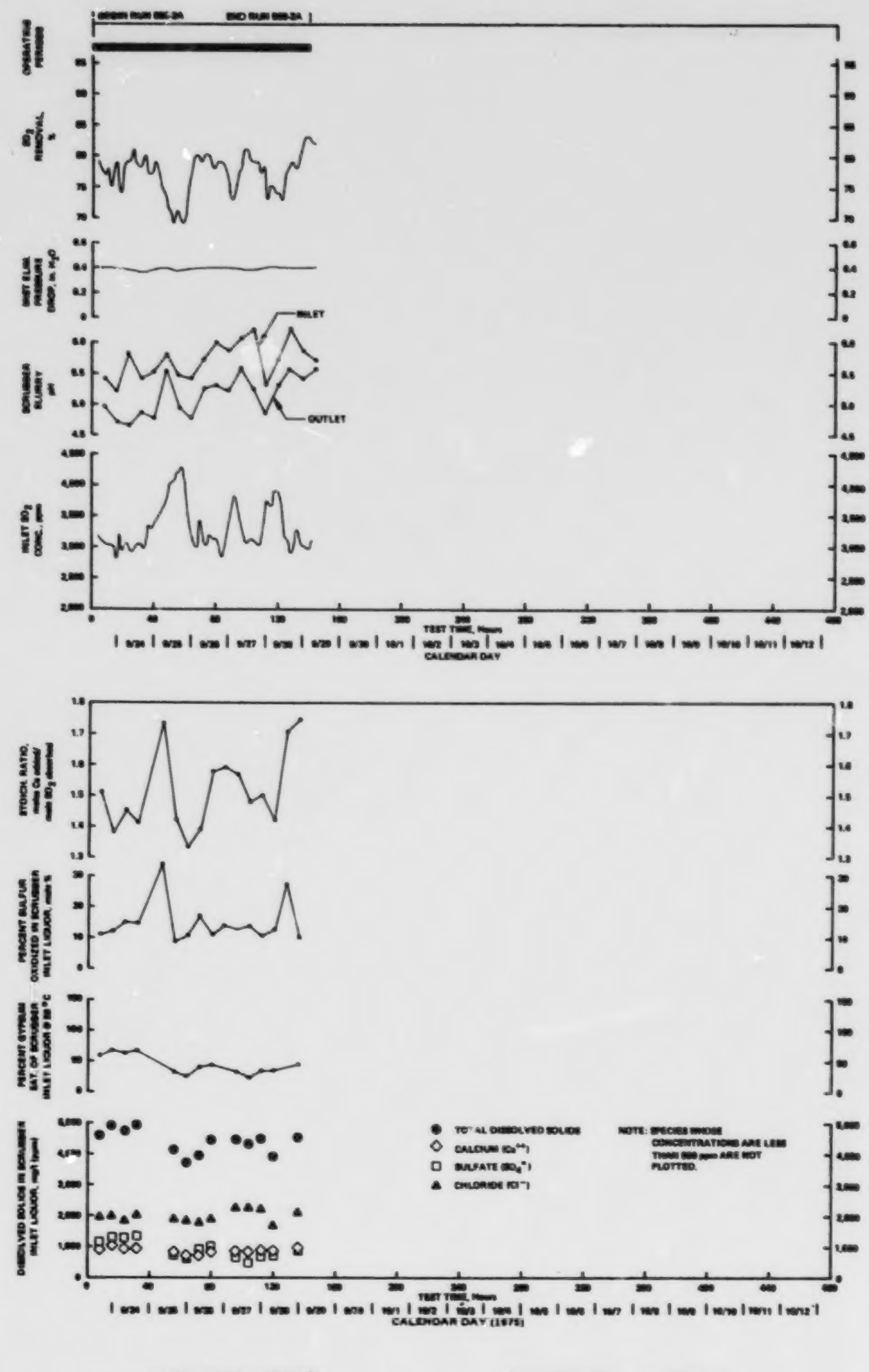
Figure I-2. OPERATING DATA FOR TCA RUN 558 - 2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 15 min
Three Stages, 5 in. spheres/stage

Percent Solids Recirculated = 14-16 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.0-8.1 in. H_2O
Scrubber Inlet Liquor Temperature = 125-127 °F
Liquid Conductivity = 3,800-4,500 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 36-42 wt %
Limestone Addition to EHT

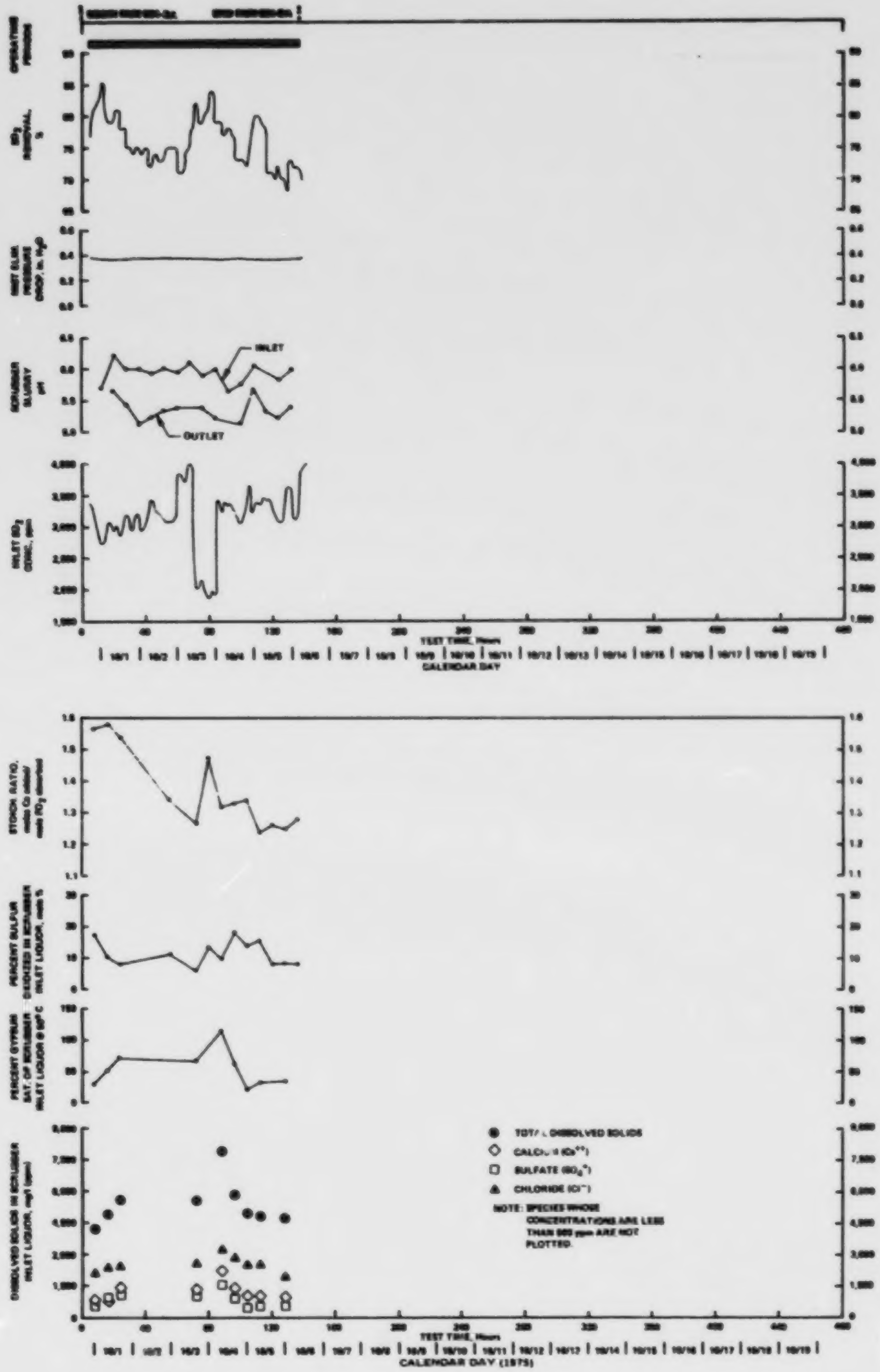
Figure I-3. OPERATING DATA FOR TCA RUN 559 - 2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 15 min
Three Stages, 5 in. sphere/stage

Percent Solids Recirculated = 14.6-15 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.0-8.1 in. H_2O
Scrubber Inlet Liquor Temperature = 123-126 °F
Liquid Conductivity = 4,900-6,500 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 38-41 wt %
Limestone Addition to EHT

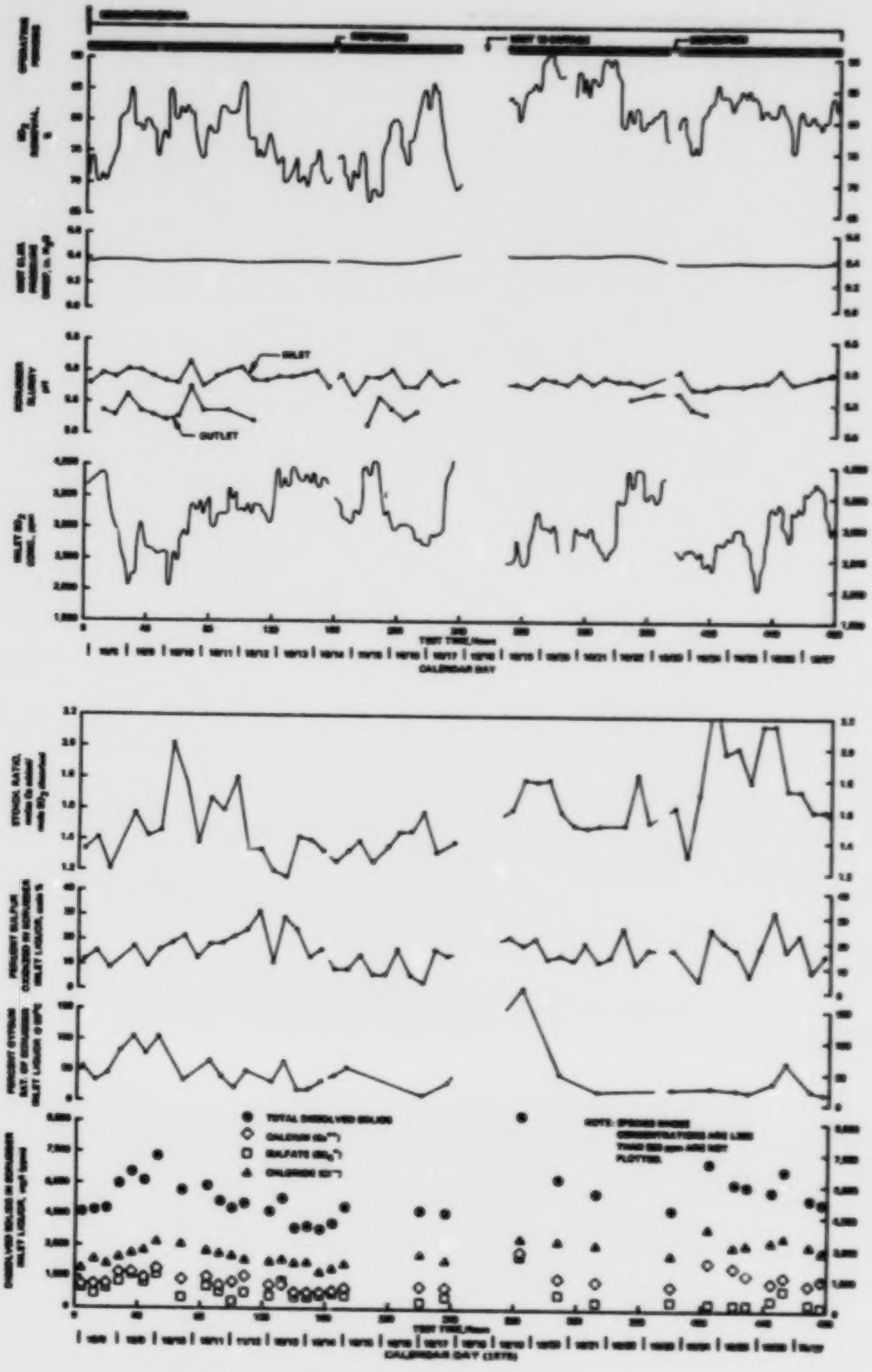
Figure I-4. OPERATING DATA FOR TCA RUN 560 - 2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 15 min
Three Stages, 5 in. spheres/stage

Percent Solids Recirculated = 14-16 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.3-7.8 in. H_2O
Scrubber Inlet Liquor Temperature = 124-128 °F
Liquid Conductivity = 6,000-7,800 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 37-44 wt %
Limestone Addition to EHT

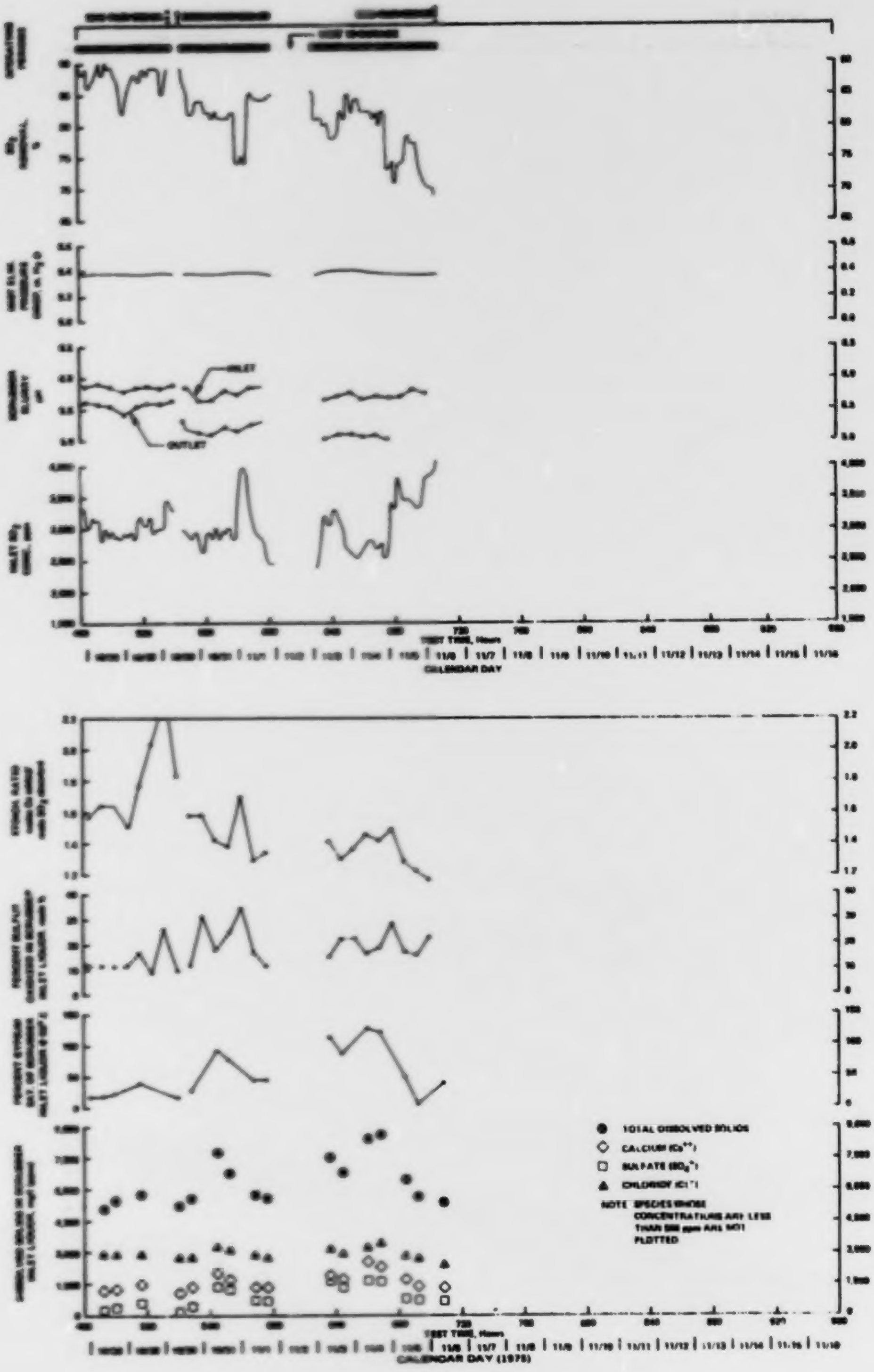
Figure I- 5. OPERATING DATA FOR TCA RUN 561-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 12 min
Three Stages, 5 in. spheres/stage

Percent Solids Recirculated = 14-15.5 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.3-7.9 in. H_2O
Scrubber Inlet Liquor Temperature = 120-128 °F
Liquid Conductivity = 5,570-8,100 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 37-43 wt %
Limestone Addition to EHT

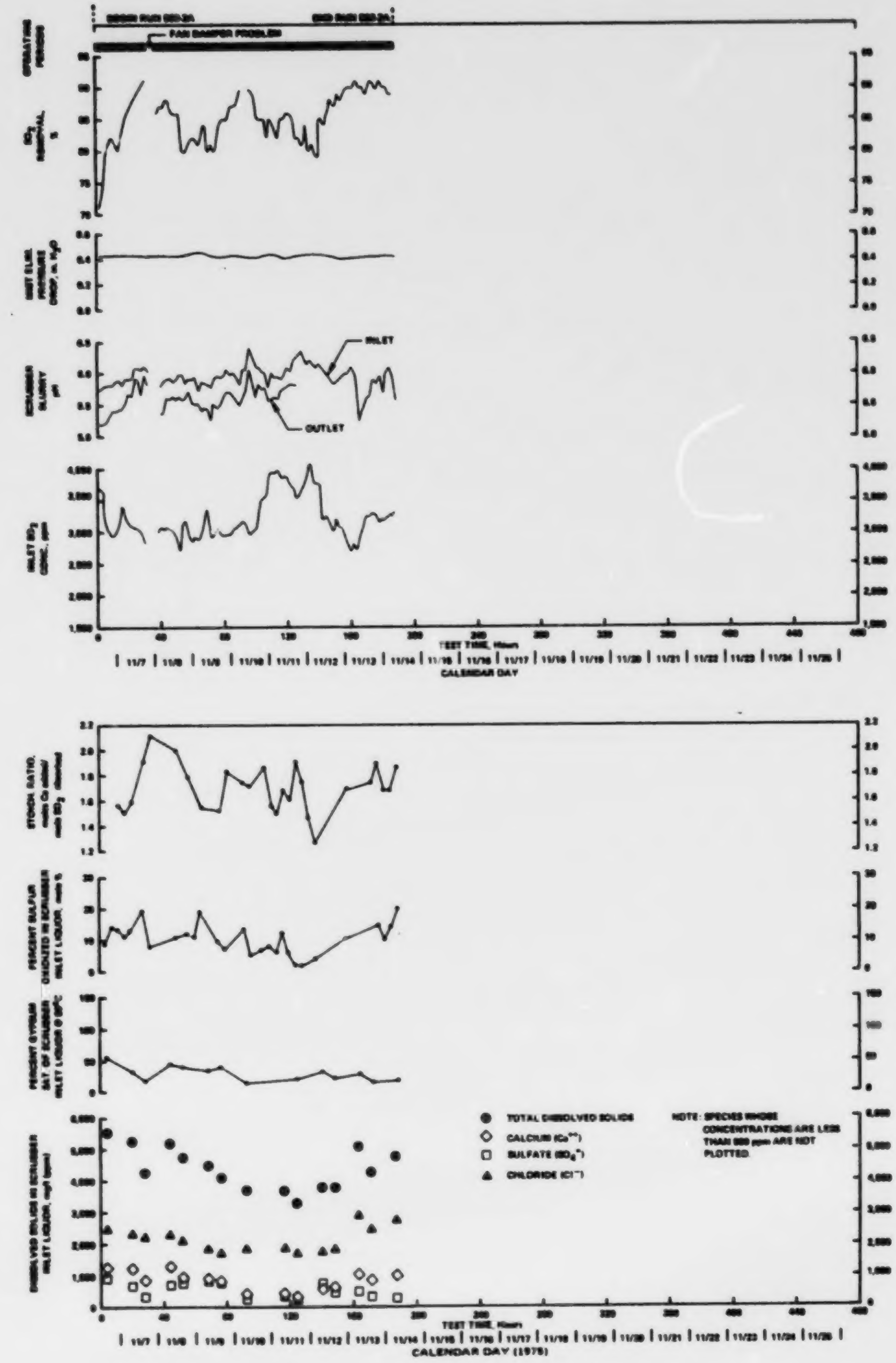
Figure 1-6. OPERATING DATA FOR TCA RUN 562-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 12 min
Three Stages, 5 in. spheres/stage
Discharge (Clarifier) Solids
Concentration = 37-43 wt % (562-2A),
34-46 wt % (562-2B)

Percent Solids Recirculated = 14-15.5 wt % (562-2A),
14-15 wt % (562-2B)
Total Pressure Drop, Excluding Mist Elim. = 7.2-7.9 in. H_2O
(562-2A), 8.0-8.8 in. H_2O (562-2B)
Scrubber Inlet Liquor Temperature = 128-130°F
(562-2A), 124-128°F (562-2B)
Liquid Conductivity = 5,570-8,100 μ mhos/cm (562-2A),
7,000-8,400 μ mhos/cm (562-2B)
Limestone Addition to EHT

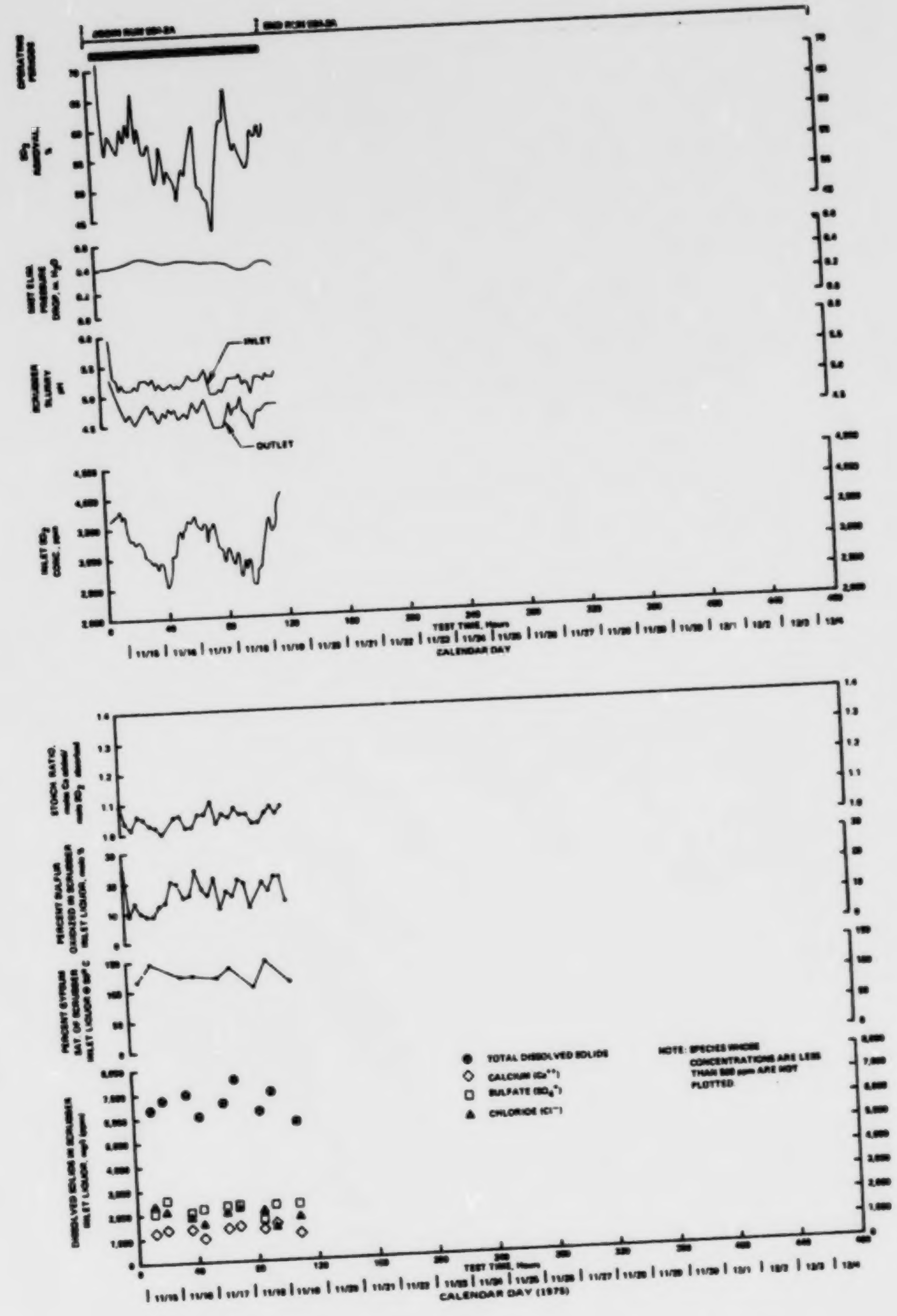
Figure I-7. OPERATING DATA FOR TCA RUNS 562-2A(Continued) & 562-2B



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 12 min
Three Stages, 5 in. spheres/stage
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

Percent Solids Recirculated = 14.8-15.6 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.8-8.1 in. H_2O
Scrubber Inlet Liquor Temperature = 121-127 °F
Liquid Conductivity = 3,700-7,200 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 38-46 wt %
Limestone Addition to EHT

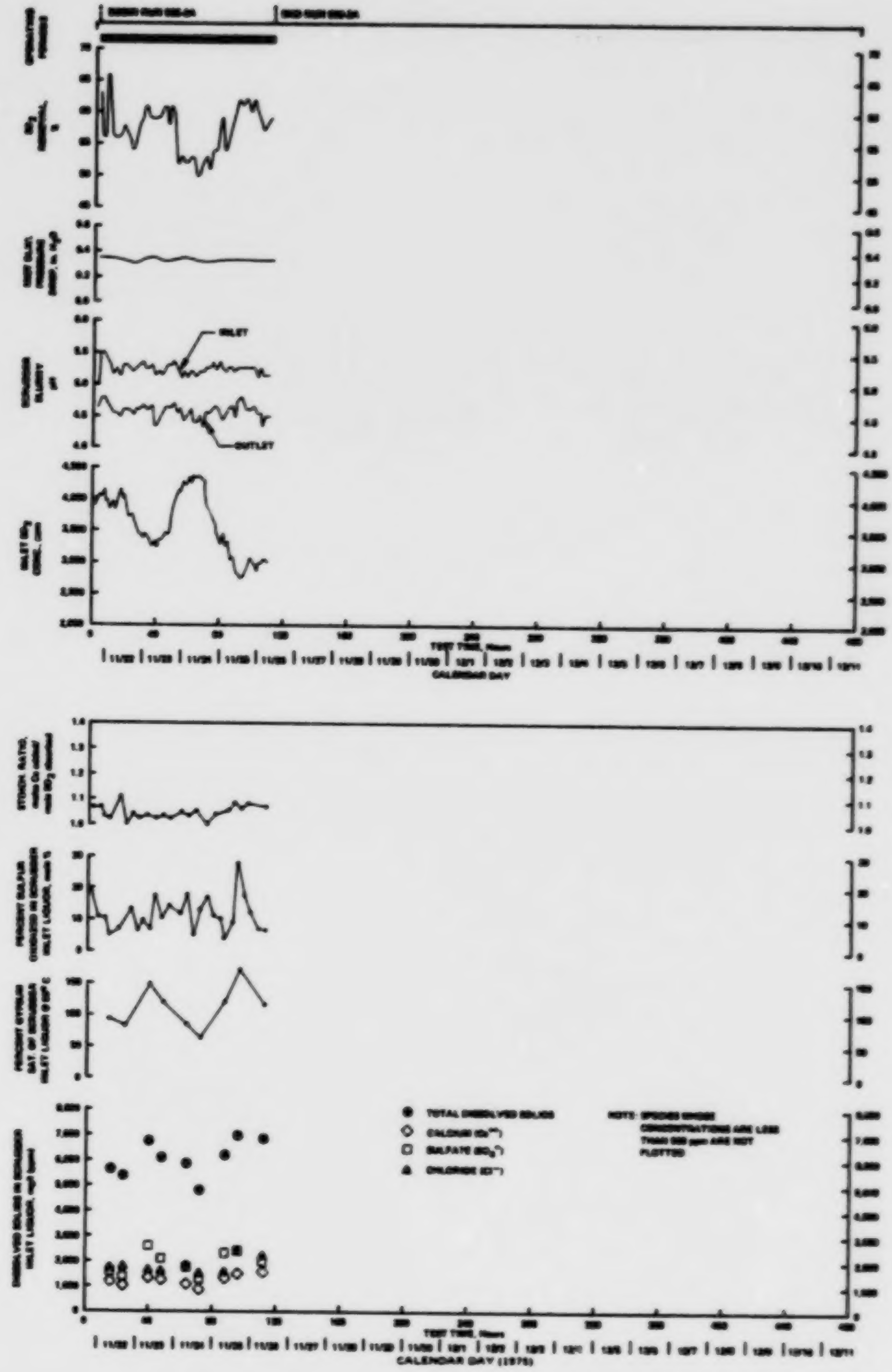
Figure I-8. OPERATING DATA FOR TCA RUN 563-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50 gal/mcf
EHT Residence Time = 12 min
Three Stages, 5 in. spheres/stage
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

Percent Solids Recirculated = 13.4-15 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.8-8.2 in. H_2O
Scrubber Inlet Liquor Temperature = 120-127 °F
Liquid Conductivity = 4,000-7,400 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 38-45 wt %
Limestone Addition to EHT

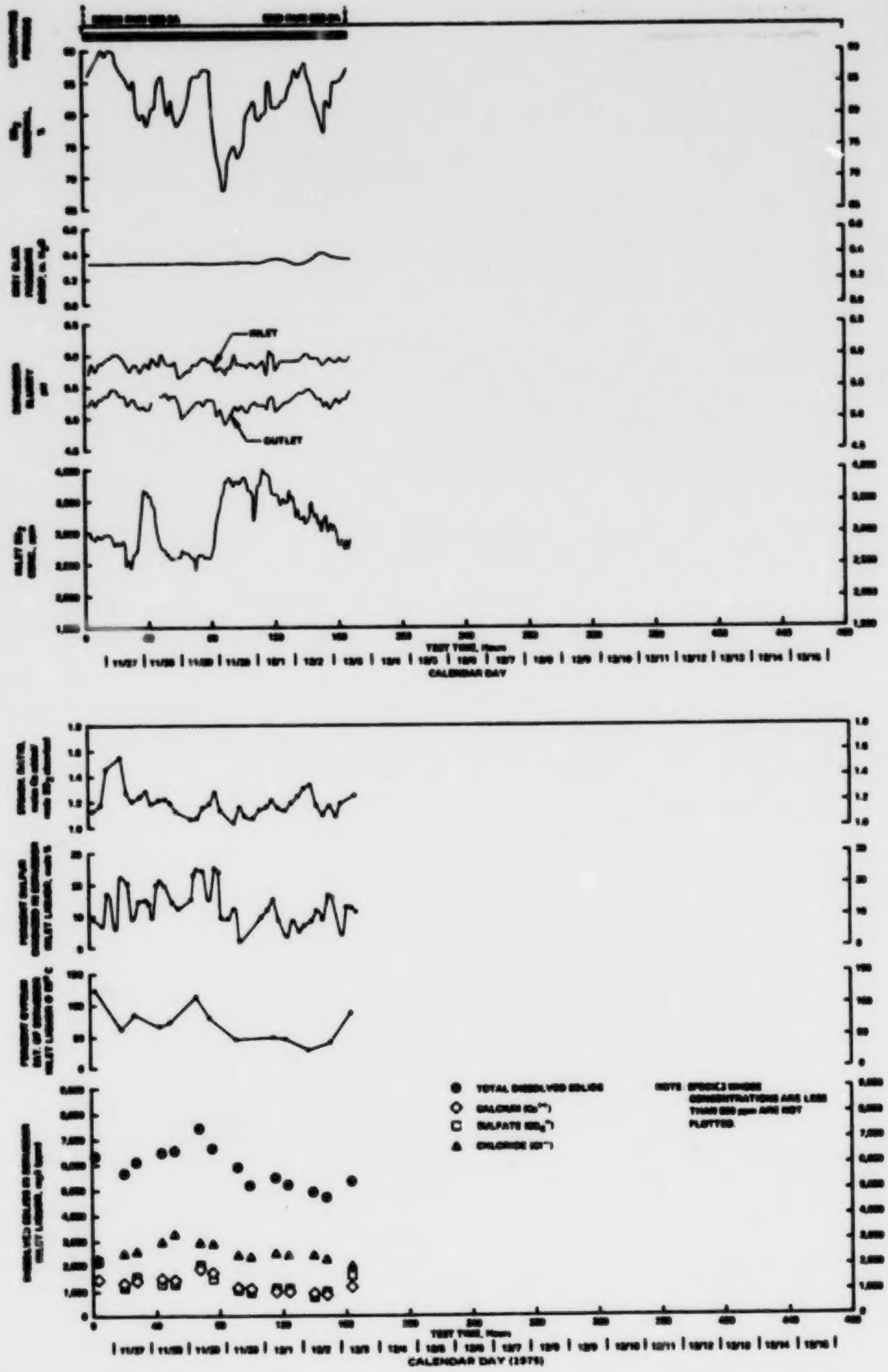
Figure I-9. OPERATING DATA FOR TCA RUN 564-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1000 gpm
L/G = 42 gal/mcf
EHT Residence Time = 14.4 min
Three Stages, 5 in. spheres/stage
Note: Only solids data points with
ionic imbalances between ± 8.0%
are plotted.

Percent Solids Recirculated = 12.8-15.4 wt %
Total Pressure Drop, Excluding Mist Elim.
= 7.4-8.0 in. H_2O
Scrubber Inlet Liquor Temperature = 123-127 °F
Liquid Conductivity = 4,800-5,900 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 34-43 wt %
Limestone Addition to EHT

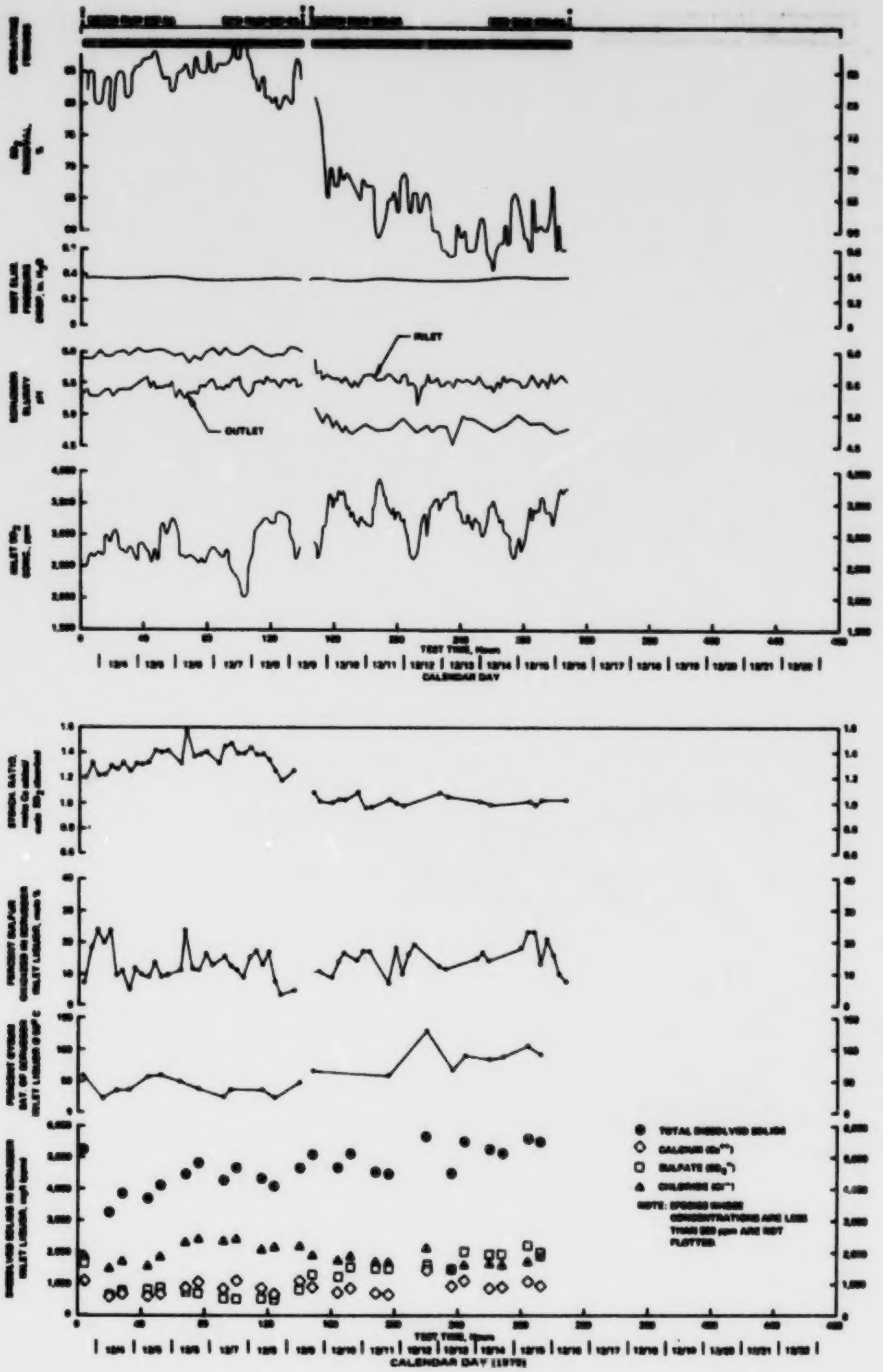
Figure I-10. OPERATING DATA FOR TCA RUN 565-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1000 gpm
L/G = 42 gal/mcf
EHT Residence Time = 14.4 min
Three Stages, 5 in. spheres/stage
Note: Only solids data points with ionic imbalances between ± 5.0% are plotted.

Percent Solids Recirculated = 13.0-15.5 wt %
Total Pressure Drop, Excluding Mist Elim. = 8.7-10.1 in. H_2O
Scrubber Inlet Liquor Temperature = 125-129 °F
Liquid Conductivity = 6,000-7,400 μ mhos/cm
Discharge (Clarifier) Solids Concentration = 34-44 wt %
Limestone Addition to EHT

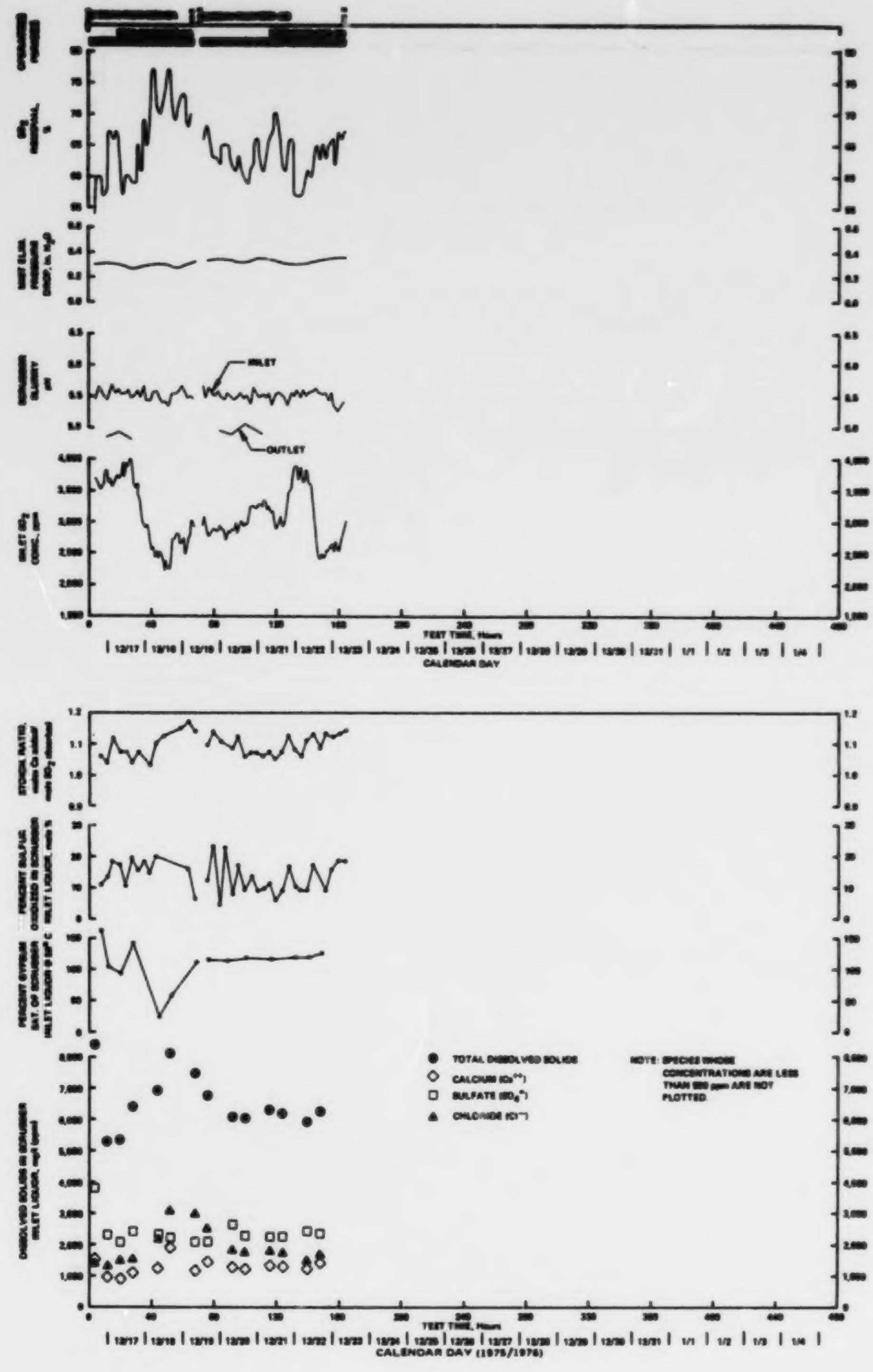
Figure I-11. OPERATING DATA FOR TCA RUN 566-2A



Gas Rate = 20,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1600 gpm
L/G = 42 gal/mcf
EHT Residence Time = 14.4 min (3 tanks)
Three Stages, 5 in. spheres/stage
Discharge (Clarifier) Solids
Concentration = 37-43 wt % (567-2A),
38-40 wt % (568-2A)

Percent Solids Recirculated = 14.7-15.6 wt % (567-2A),
14.5-15.3 wt % (568-2A)
Total Pressure Drop, Excluding Mist Elim. = 8.8-9.5 in. H_2O
(567-2A), 8.8-10.0 in. H_2O (568-2A)
Liquid Conductivity = 5,700-6,800 μ mhos/cm (567-2A),
4,000-6,100 μ mhos/cm (568-2A)
Limestone Addition to First EHT
Note: Only solids data points with
ionic imbalances between ± 5.0%
are plotted.

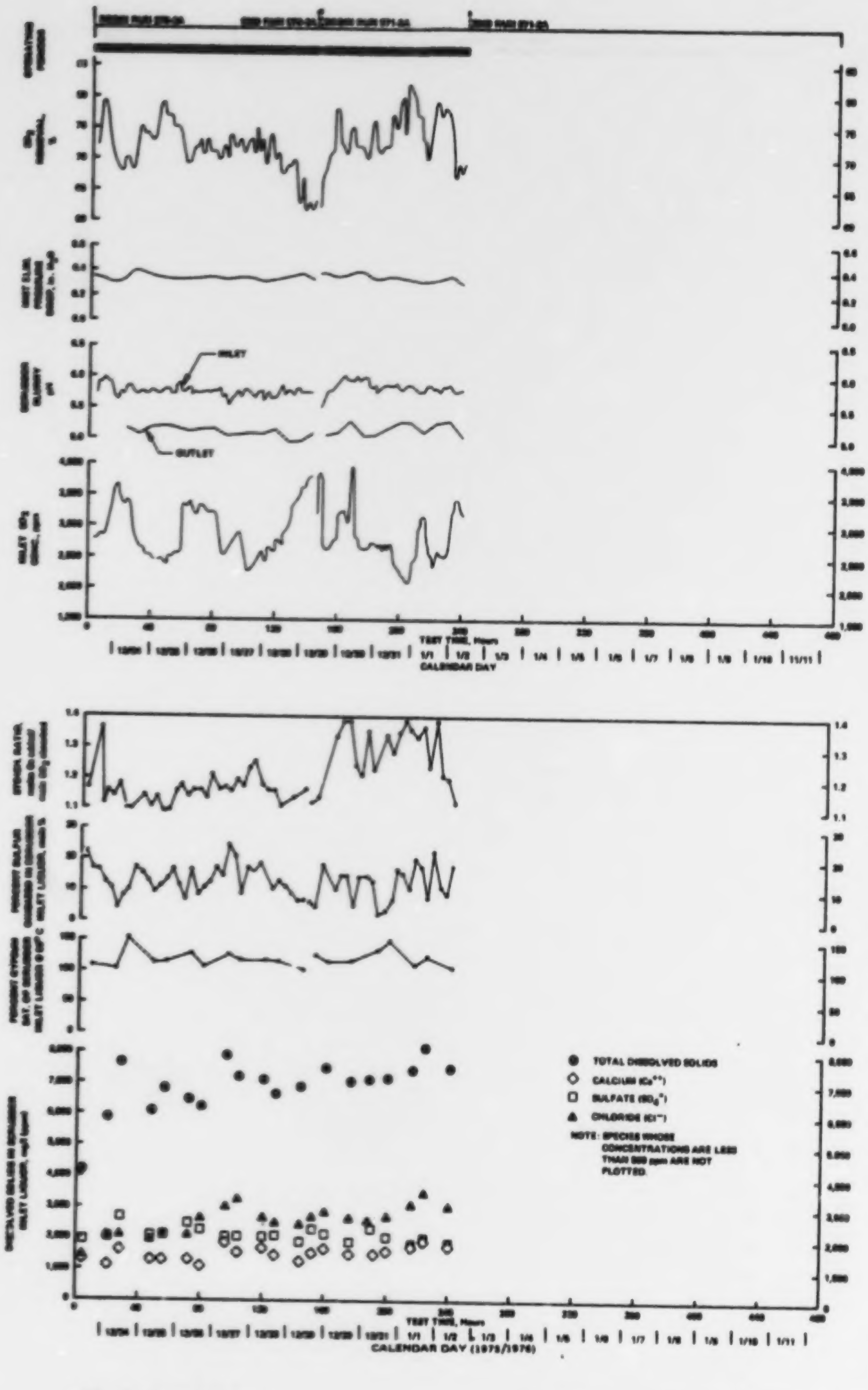
Figure I-12. OPERATING DATA FOR TCA RUNS 567-2A & 568-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1000 gpm
L/G = 42 gal/mcf
EHT Residence Time = 10.8 min (3 tanks)
Three Stages, 5 in. spheres/stage
Discharge (Clarifier) Solids
Concentration = 33-44 wt % (569-2A),
37-44 wt % (569-2B)

Percent Solids Recirculated = 14.4-15.4 wt % (569-2A),
14.8-15.5 wt % (569-2B)
Total Pressure Drop, Excluding Mist Elim. = 7.8-8.9 in. H_2O
(569-2A), 7.2-8.6 in. H_2O (569-2B)
Liquid Conductivity = 4,800-8,100 μ mhos/cm (569-2A),
5,900-8,600 μ mhos/cm (569-2B)
Limestone Addition to First EHT
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

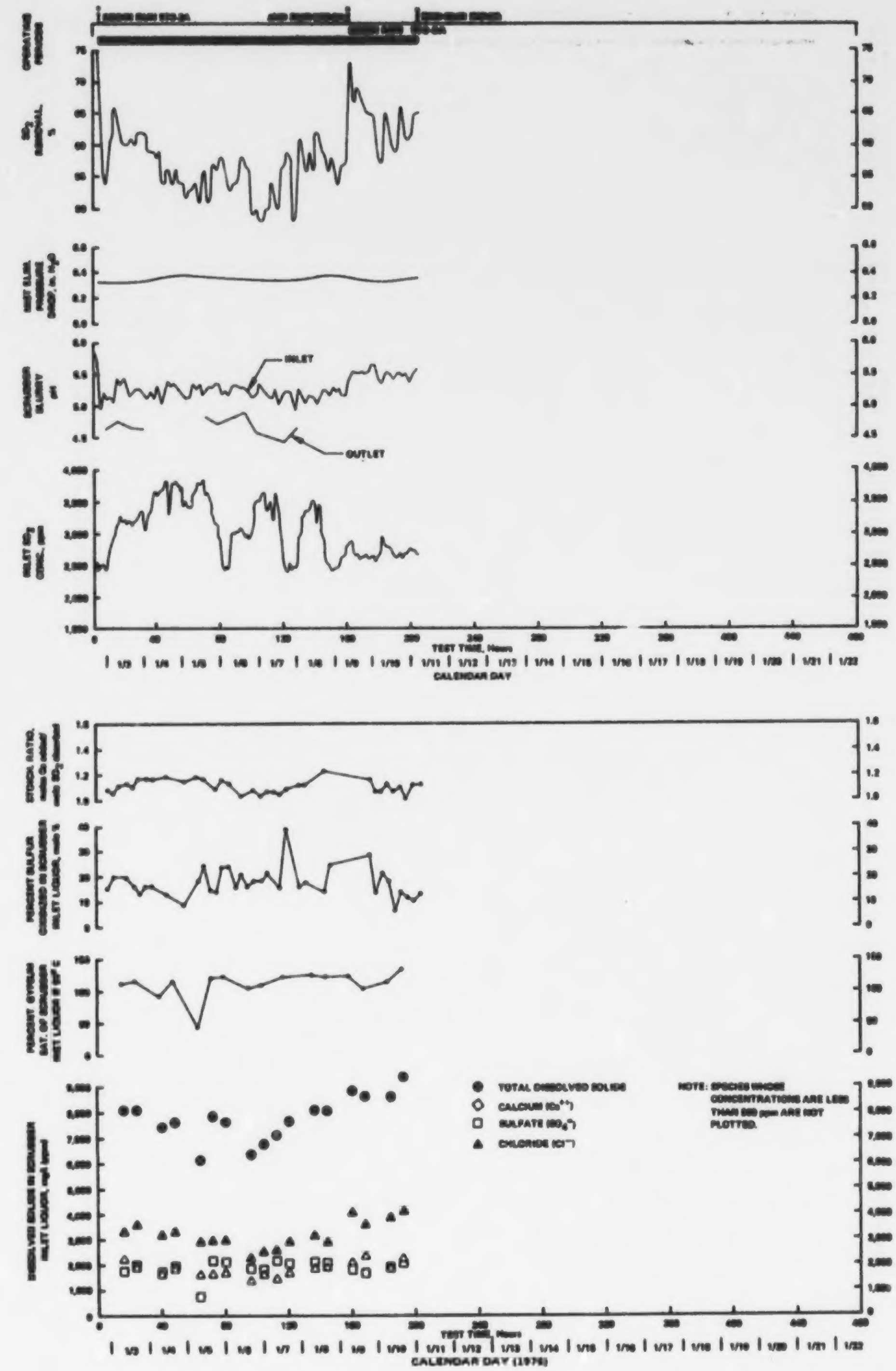
Figure I-13. OPERATING DATA FOR TCA RUNS 569-2A & 569-2B



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 42 gal/mcf
EHT Residence Time = 10.8 min (2 tanks)
Three Stages, 5 in. spheres/stage
Discharge (Clarifier) Solids
Concentration = 34-41 wt % (570-2A),
34-42 wt % (571-2A)

Percent Solids Recirculated = 13.8-15.4 wt % (570-2A),
14.2-15.8 wt % (571-2A)
Total Pressure Drop, Excluding Mist Elim. = 6.0-8.1 in. H_2O
(570-2A), 6.7-7.3 in. H_2O (571-2A)
Liquid Conductivity = 5,800-8,900 μ mhos/cm (570-2A),
8,400-10,400 μ mhos/cm (571-2A)
Limestone Addition to First EHT
Note: Only solids data points with
ionic imbalances between ± 5.5%
are plotted.

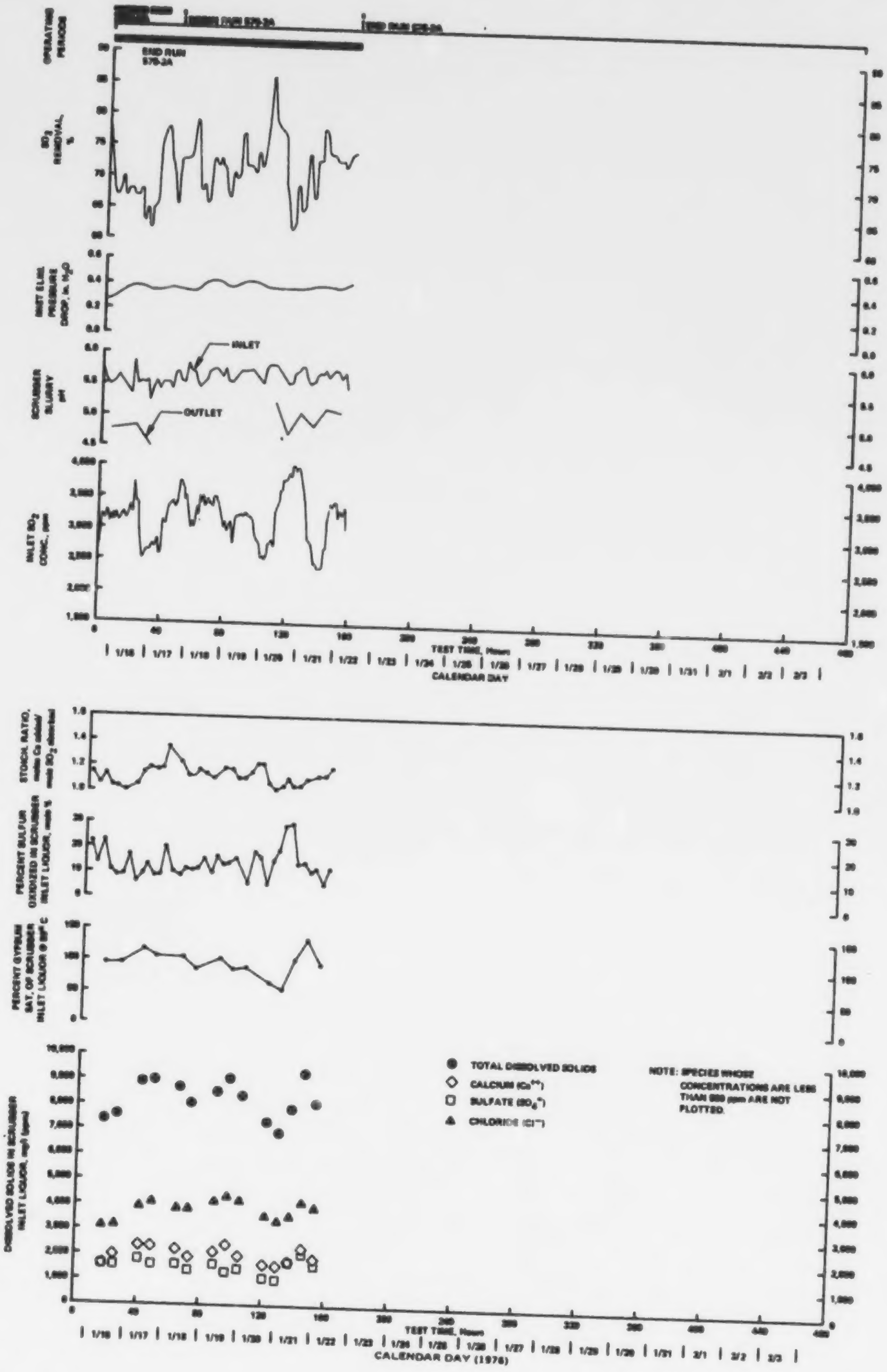
Figure I-14. OPERATING DATA FOR TCA RUNS 570-2A & 571-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1600 gpm
L/G = 42 gal/mcf
EHT Residence Time = 18.8 min , 3 tanks
(572-2A); 14.4 min , 3 tanks (573-2A)
Three Stages, 5 in. spheres/stage
Discharge (Clarifier) Solids
Concentration = 34-47 wt % (572-2A),
34-43 wt % (573-2A)

Percent Solids Recirculated = 14-15 wt % (572-2A),
14.5-15.5 wt % (573-2A)
Total Pressure Drop, Excluding Mist Elim. = 6.3-7.1 in. H_2O
(572-2A), 6.7-7.1 in. H_2O (573-2A)
Liquid Conductivity = 7,100-11,000 µ mhos/cm (572-2A),
Limestone Addition to First EHT
Note; Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

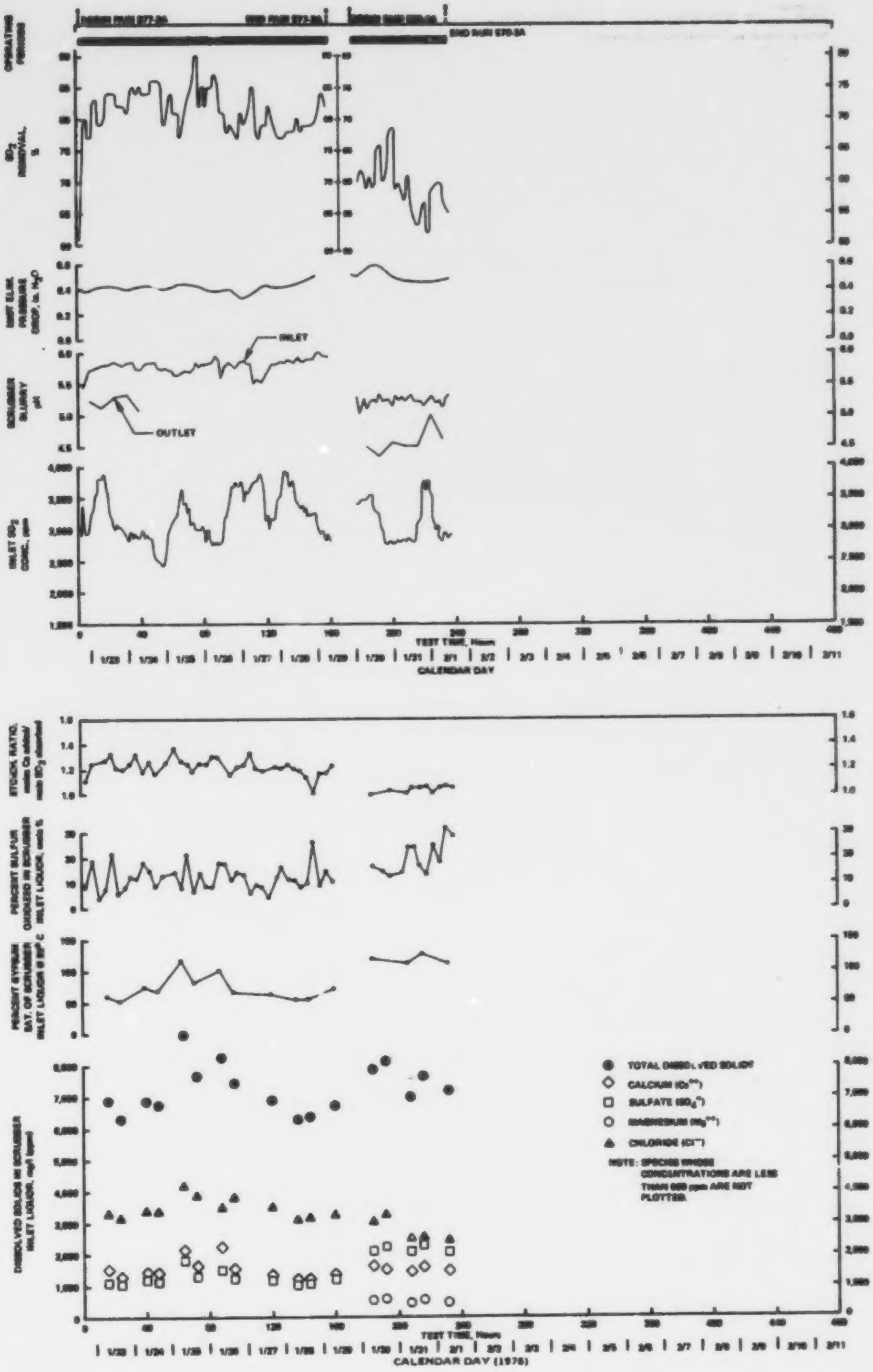
Figure I-15. OPERATING DATA FOR TCA RUNS 572-2A & 573-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.[illegible] ft/sec
Liquor Rate = 1000 gpm
L/G = 42 gal/mcf
EHT Residence Time = 14.4 min (3 tanks)
Three Stages, 5 in. spheres/stage
Discharge (Clarifier) Solids
Concentration = 35-39 wt % (575-2A),
37-42 wt % (576-2A)

Percent Solids Recirculated = 14-15.5 wt % (575-2A),
14.8-15.5 wt % (576-2A)
Total Pressure Drop, Excluding Mist Elim. = 6.1-7.2 in. H_2O (575-2A), 7.1-7.9 in. H_2O (576-2A)
Liquid Conductivity = 7,400-9,300 μ mhos/cm (575-2A),
8,300-10,100 μ mhos/cm (576-2A)
Limestone Addition to First EHT
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

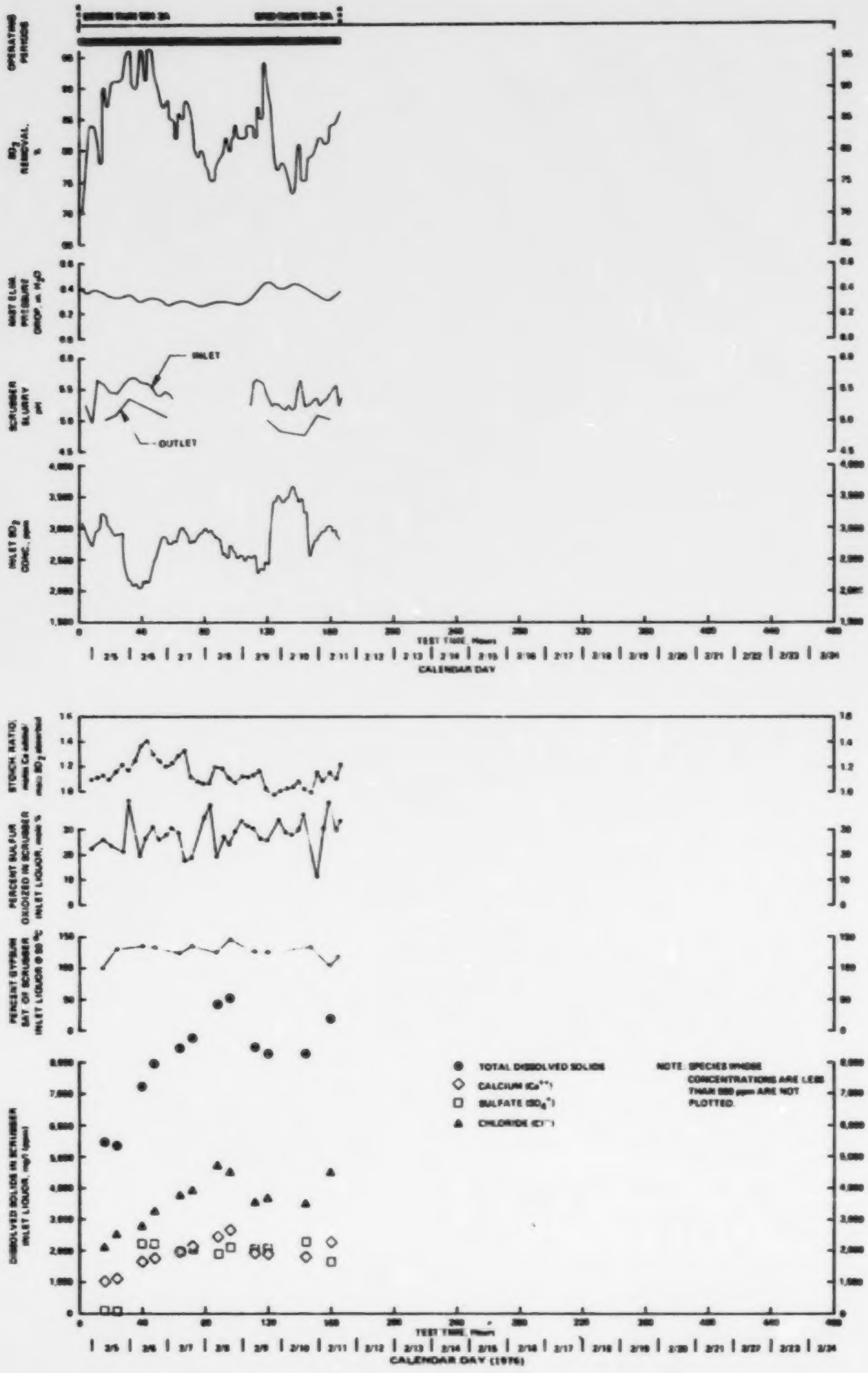
Figure 1-16. OPERATING DATA FOR TCA RUNS 575-2A & 576-2A



Gas Rate = 30,000 acfm @ 300 °F
Gas Velocity = 12.5 ft/sec
Liquor Rate = 1000 gpm
L/G = 42 gal/mcf
EHT Residence Time = 14.4 min , 3 tanks
(577-2A); 10.8 min , 3 tanks (579-2A)
Three Stages, 5 in. spheres/stage
Discharge (Clarifier) Solids
Concentration = 39-43 wt % (577-2A),
40-45 wt % (579-2A)

Percent Solids Recirculated = 14-15.5 wt % (577-2A),
14.5-15.3 wt %(579-2A)
Total Pressure Drop, Excluding Mist Elim. = 8.0-8.6 in. H_2O
(577-2A), 9.3-10.1 in. H_2O (579-2A)
Liquid Conductivity = 7,400-13,000 μ mhos/cm (577-2A)
Limestone Addition to First EHT
Note: Only solids data points with
ionic imbalances between ± 8.5%
are plotted.

Figure I-17. OPERATING DATA FOR TCA RUNS 577-2A & 579-2A



Gas Rate = 27,000-30,000 acfm @ 300 °F
Gas Velocity = 11.5-12.5 ft/sec
Liquor Rate = 1200 gpm
L/G = 50-54 gal/mcf
EHT Residence Time = 12 min
Three Stages, 8 in. spheres/stage
Note: Only solids data points with
ionic imbalances between ± 5.0%
are plotted.

Percent Solids Recirculated = 14-15.5 wt %
Total Pressure Drop, Excluding Mist Elim.
= 8.7-14.4 in. H_2O
Liquid Conductivity = 5,300-8,300 μ mhos/cm
Discharge (Clarifier) Solids
Concentration = 35-42 wt %
Limestone Addition to EHT

Figure I-18. OPERATING DATA FOR TCA RUN 581-2A

Appendix J

AVERAGE LIQUOR COMPOSITIONS FOR THE TCA TESTS

Table J-1

AVERAGE LIQUOR COMPOSITIONS FOR TCA LIMESTONE RUNS FROM JUNE 1975 TO NOVEMBER 1975

Run No.	Percent Solids Discharged	Percent Sulfur Oxidized	Sample Point	pH	Liquor Species Concentration, mg/l (ppm)									Calculated Percent Sulfate Saturation at 50°C[(a)]
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$SO_3^{=}$	$SO_4^{=}$	$CO_3^{=}$	Cl^{-}	Total	
546-2A	35-44	10-25	Scrubber Inlet	5.85	1440	190	40	60	90	1310	90	2220	5400	90
			Scrubber Outlet	5.40	1450	190	35	50	170	1320	80	2200	5500	90
			Clarifier Overflow	7.15	1190	170	35	45	75	1140	85	2060	4800	75
557-2A	39-44	10-21	Scrubber Inlet	5.95	990	280	70	85	85	1270	80	1690	4600	70
			Scrubber Outlet	5.55	1050	270	65	85	175	1470	90	1620	4800	80
			Clarifier Overflow	7.25	1100	290	80	110	180	1210	75	1700	4700	70
558-2A	34-42	10-20	Scrubber Inlet	5.85	1060	330	45	60	110	1610	70	1660	4900	85
			Scrubber Outlet	5.35	1130	315	45	60	150	1770	65	1600	5100	100
			Clarifier Overflow	6.85	1100	290	45	50	120	1630	40	1750	5000	90
559-2A	36-42	7-24	Scrubber Inlet	5.85	910	370	45	60	95	1390	100	1770	4700	70
			Scrubber Outlet	5.30	920	365	50	60	110	1320	110	1660	4600	65
			Clarifier Overflow	7.25	1050	400	50	65	80	1500	80	1810	5000	75
560-2A	36-41	9-17	Scrubber Inlet	5.65	860	360	65	85	50	910	100	1970	4400	45
			Scrubber Outlet	4.95	840	370	65	80	105	950	110	1840	4400	45
			Clarifier Overflow	7.10	940	380	50	60	8	840	80	2200	4600	40

Note: The values in this table are averages for the steady-state operating periods.

(a) (activity Ca^{++}) x (activity $SO_4^{=}$)/(solubility product at 50°C). Estimated solubility product for $CaSO_4 \cdot 2H_2O$ at 50°C is 2.2×10^{-5} (Radian Corporation, "A Theoretical Description of the Limestone-Injection Wet Scrubbing Process", NAPCA Report, June 9, 1970).

Table J-2

AVERAGE SCRUBBER INLET LIQUOR COMPOSITIONS FOR TCA LIMESTONE RUNS MADE FROM NOVEMBER 1975 TO FEBRUARY 1976

Run No.	Percent Solids Discharged	Percent Sulfur Oxidized	pH	Liquor Species Concentrations, mg/l (ppm)									Calculated Percent Sulfate Saturation at 50°C(a)
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$SO_3^{=}$	$SO_4^{=}$	$CO_3^{=}$	Cl^{-}	Total	
561-2A	37-44	6-18	5.90	1270	370	50	55	60	950	70	2600	5400	55
562-2A	37-43	5-30	5.90	1350	370	50	55	70	710	80	2700	5400	40
562-2B	34-46	10-30	5.65	1730	450	60	65	115	1120	140	2980	6700	70
563-2A	36-46	2-23	5.85	830	400	50	55	115	580	170	2070	4300	25
564-2A	38-45	9-23	5.15	1300	360	45	60	600	2260	17	1960	6600	120
565-2A	34-43	5-19	5.25	1220	370	35	55	540	1960	23	1800	6000	105
566-2A	34-44	2-25	5.85	1220	525	45	55	95	1410	130	2490	6000	60
567-2A	37-43	4-24	5.95	820	410	45	55	80	730	150	2020	4300	35
568-2A	38-46	7-30	5.55	870	460	45	65	130	1770	60	1790	5200	75
569-2A	33-44	6-23	5.50	1340	500	55	70	160	2280	80	2060	6500	115
569-2B	37-44	4-23	5.50	1330	460	40	60	140	2270	70	1880	6300	120
570-2A	34-41	5-25	5.80	1430	490	40	65	75	2200	65	2310	6700	115
571-2A	34-42	3-23	5.80	1800	480	45	70	95	2150	75	2900	7600	130
572-2A	34-47	10-29	5.25	1740	490	50	70	215	1920	45	3050	7600	110
573-2A	34-43	6-28	5.55	2220	620	60	75	105	1950	40	3890	8900	120
575-2A	35-39	6-23	5.50	2010	570	55	70	105	1760	30	3590	8200	105
576-2A	37-42	6-23	5.70	2010	550	60	70	110	1530	70	3910	8300	95
577-2A	39-43	5-20	5.80	1560	510	55	60	75	1290	85	3490	7100	70
579-2A	40-45	12-28	5.25	1580	590	60	65	255	2270	20	3260	8100	120
581-2A	35-42	18-40	5.45	1890	470	45	60	105	2110	40	3430	8200	125

Note: The values in this table are averages for the steady-state operating periods.

(a) (activity Ca^{++}) x (activity $SO_4^{=}$)/(solubility product at 50°C). Estimated solubility product for $CaSO_4 \cdot 2H_2O$ at 50°C is 2.2×10^{-5} (Radian Corporation, "A Theoretical Description of the Limestone-Injection Wet Scrubbing Process", NAPCA Report, June 9, 1970).

Appendix K

ANALYTICAL PRECISION AND ACCURACY PROCEDURES

ANALYTICAL PRECISION

Precision of an analytical method refers to the reproducibility of the results by that method of multiple analyses performed on the same sample.

Analytical precision is determined at Shawnee from repeated analysis of routine liquor and solid samples. These samples are chosen to encompass the ranges of concentration of the substance being analyzed and of the concentrations of interfering substances usually encountered in the analytical procedure. For each procedure, a mean normalized precision $\overline{P}$, an upper warning limit UWL, and an upper control limit UCL have been developed. For example, numbers made up to simulate the results of duplicate analyses by a single procedure performed on each of fifteen samples are tabulated in Table K-1. Calculations of the normalized precision value P for each sample pair, the mean normalized precision $\overline{P}$, the upper warning limit UWL, and the upper control limit UCL for the analytical method using this data are also shown. It can be seen from the calculations that if precision were perfect, $\overline{P}$ would be zero. From these parameters, "Modified Shewhart Precision Control Charts"*, have been produced. Use of this kind of control chart is discussed below.

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* "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," EPA Quality Control Laboratory, Cincinnati, Ohio.

Representative upper control limits (UCL) for the liquid and solid analyses performed at Shawnee are shown in Figures K-1 and K-2, respectively. These UCL values were based on analyses performed during June and July of 1975. The data shown in Figures K-1 and K-2 are used to flag analytical methods that are unsuitable for the Shawnee laboratory. For example, because the precision of the liquid sulfite procedure was poor, as indicated by the large value of its upper control limit (shown in Fig. K-1), this procedure or the equipment used had to be improved or replaced (see Subsection 9.2.3).

Precision control charts such as that in Figure K-3 are also used to warn of analytical difficulty. In practice, these charts are used as follows. The normalized precision P of the replicate analyses is calculated as shown in Table K-1. This value is plotted on the control chart. If the precision is greater than the UCL, the results of the analysis are out of bounds and are not considered valid. Efforts to rectify the problem are undertaken. If the precision lies between the UWL and UCL, analyses are continued while efforts are made to isolate the cause of the variation in the data. If the precision is less than the UWL, the results are considered satisfactory.

ANALYTICAL DATA ACCURACY

The accuracy of an analytical procedure refers to the degree of difference between the measured value determined by use of the procedure (for example, the concentration of a substance in a sample) and the actual value.

Accuracy is currently determined at Shawnee by the use of carefully prepared synthetic liquor samples or spiked slurry solids sent as blind samples from Bechtel, San Francisco to the Shawnee Laboratory. The samples are selected to span the normal concentration ranges.

The accuracy of the analytical results at Shawnee has been evaluated using a modification of the general procedures and calculations outlined by the EPA.* Accuracy is indicated by two parameters - range R, and average error $\bar{X}$. Both measures of analytical accuracy are required for complete evaluation of accuracy data.

An example calculation of range and average error for the results of three replicate analyses on each of five separate samples analysed by the same analytical method is shown in Table K-2. The same calculation procedure may also be used on five sets of triplicate analyses, all drawn from the same sample but done at different times or done by five different analysts to determine valid measures of R and $\overline{X}$.

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* "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," EPA Analytical Quality Control Laboratory, Cincinnati, Ohio, June 1972.

Limits to range and average error for the example are also calculated in Table K-2. These are:

- Upper control and warning limits (UCL_R, UWL_R) for the range, R.
- Upper control and upper warning limits ($UCL_{\overline{X}}$ and $UWL_{\overline{X}}$) on the average error.

The constants A_2 and D_4 used in the calculations are given in Table K-3.

These values are used in control charts in the same way as described above for precision upper warning and upper control limits, except that there are two measures of analytical accuracy. Hence, two control charts should be employed, one for the range R and one for the average error $\overline{X}$.

Limits on R or $\overline{X}$ alone do not completely characterize the accuracy of analytical procedures. For example, the range may be zero (all answers the same), yet the answers could be incorrect by any amount. Thus, limits on R alone are insufficient. Similarly, the differences between found and actual concentrations could cancel exactly (high results canceling low results) but the range of results could be wide. In this case the range would indicate the accuracy of the data and limits on $\overline{\overline{X}}$ alone would be insufficient. Only limits on both $\overline{\overline{X}}$ and R will provide adequate characterization of accuracy data collected as part of a quality assurance program.

The $UCL_{\overline{\overline{X}}}$ and $UCL_{\overline{R}}$ values for selected liquor analyses are shown in Figure K-4. Accuracy data are not yet available for liquid sulfite and carbonate analyses, or for solid calcium, sulfur, magnesium, or carbonate analyses. The accuracy of the solid calcium, sulfur and magnesium analyses has been assessed, but not in a manner that lends itself to the development of control charts (see discussion, Section 9).

Table K-1

EXAMPLE CALCULATIONS OF NORMALIZED PRECISION VALUES, UPPER CONTROL LIMITS AND UPPER WARNING LIMITS, FOR A REPRESENTATIVE ANALYSIS PROCEDURE

Duplicate Concentration Values Found		Normalized Precision, $P = \left\|\frac{X1 - X2}{X1 + X2}\right\|$
X1	X2	
51	52	0.0097
40	38	0.0156
37	37	0
22	25	0.0638
78	77	0.0064
83	82	0.0061
50	50	0
62	57	0.0420
48	46	0.0213
50	49	0.0101
71	73	0.0139
82	83	0.0061
77	76	0.0065
40	40	0.0526
43	45	0.0227

Number of Duplicate Pairs, $n = 15$

Mean Normalized Precision, $\overline{P} = 0.016$

1 Standard Deviation of $\overline{P}$, $\sigma_P = 0.018$

Upper Warning Limit, UWL = $2\sigma_P = 0.035$

Upper Control Limit, UCL = $3\sigma_P = 0.053$

Note

Mean Normalized Precision = $(\sum P)/n = \overline{P}$

Standard Deviation of $\overline{P}$ = $[(\Sigma P^2 - n\overline{P}^2)/(n-1)]^{1/2}$

Table K-2

EXAMPLE CALCULATIONS OF THE CONTROL LIMITS FOR AVERAGE ERROR AND RANGE FOR A REPRESENTATIVE ANALYTICAL PROCEDURE

ACTUAL VALUE	VALUE FOUND	AVERAGE ERROR $\bar{X}$	RANGE R
990	1010 1100 980	+0.040	0.121
560	570 520 590	0	0.125
1050	1110 1040 1050	+0.016	0.067
870	910 850 850	0	0.069
960	960 990 980	+0.017	0.031

$$X = \frac{\text{Found - Actual}}{\text{Actual}}$$

η = number of observations per subgroup = 3

$$\bar{X} = \frac{\Sigma X}{\eta}$$

$$R = \frac{\text{High Found - Low Found}}{\text{Actual}}$$

n = number of subgroups = 5

$$\bar{R} = \frac{\Sigma R}{n} = \frac{0.413}{5} = 0.083$$

Upper Control Limit ($UCL_{\bar{X}}$) and Upper Warning Limit ($UWL_{\bar{X}}$) for Average Error

$UCL_{\bar{X}} = A_2\bar{R} = 1.02 \times 0.083 = 0.085$

$UWL_{\bar{X}} = (2/3)\ A_2\bar{R} = 0.056$

Upper Control Limit (UCL_R) and Upper Warning Limit (UWL_R) for Range

$UCL_R = D_4\bar{R} = 2.58 \times 0.083 = 0.214$

$UWL_R = (2/3)(D_4\bar{R} - \bar{R}) + \bar{R} = 0.170$

Table K-3

FACTORS FOR COMPUTING ACCURACY CONTROL AND WARNING LIMITS*

Observations in Subgroup (n)	Factor A_2	Factor D_4
2	1.88	3.27
3	1.02	2.58
4	0.73	2.28
5	0.58	2.12
6	0.48	2.00
7	0.42	1.92
8	0.37	1.86

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* Reference: "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," EPA Quality Control Laboratory, Cincinnati, Ohio, 1972.

FIGURE K -1

UPPER CONTROL LIMITS FOR LIQUID ANALYSES

DULPLICATE PRECISION (NORMALIZED) 6/9/75 TO 6/22/75 AND 7/1/75 TO 7/10/75

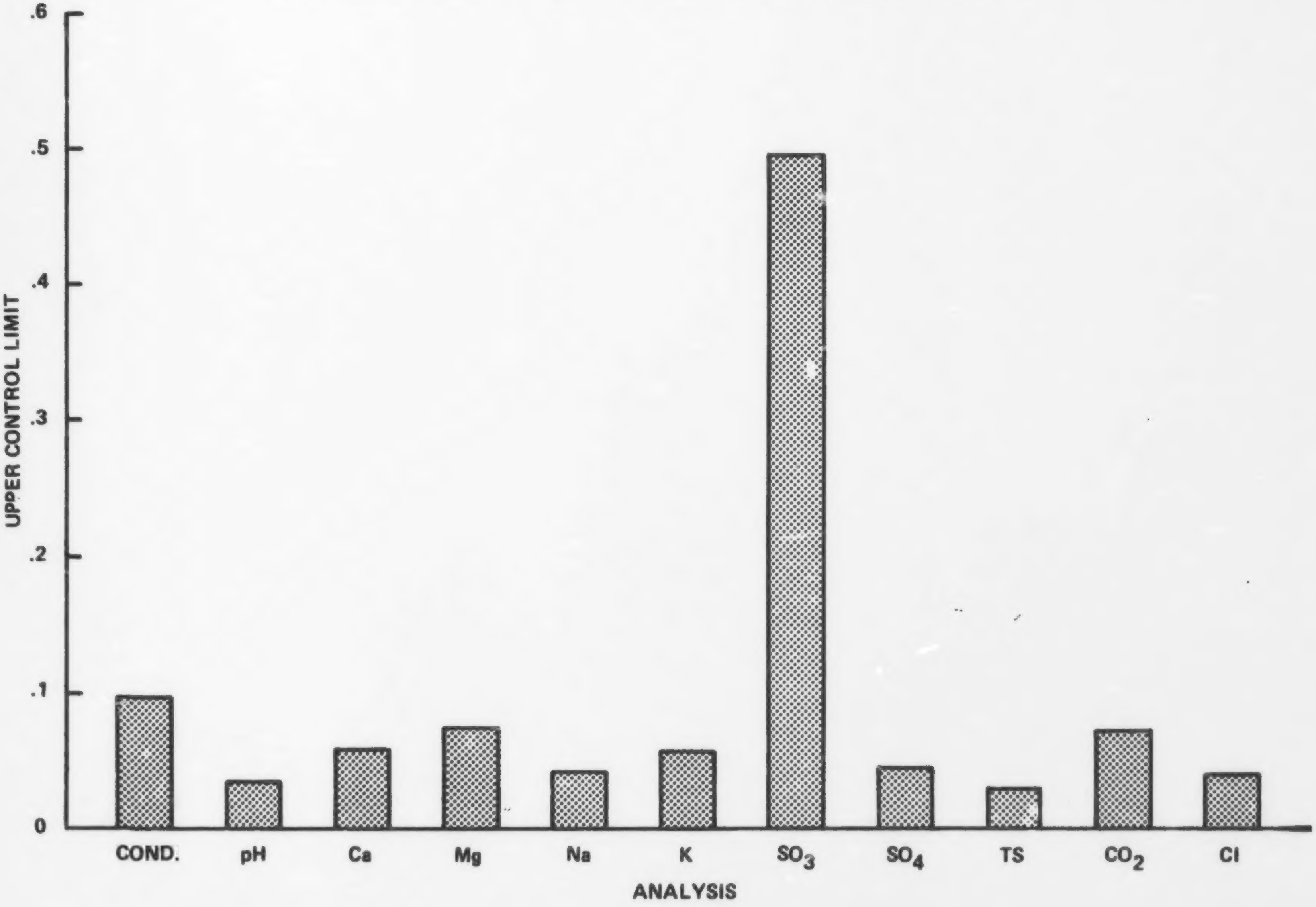


FIGURE K - 2

UPPER CONTROL LIMITS FOR SOLIDS ANALYSES
DUPLICATE PRECISION (NORMALIZED) 6/9/75 TO 6/22/75

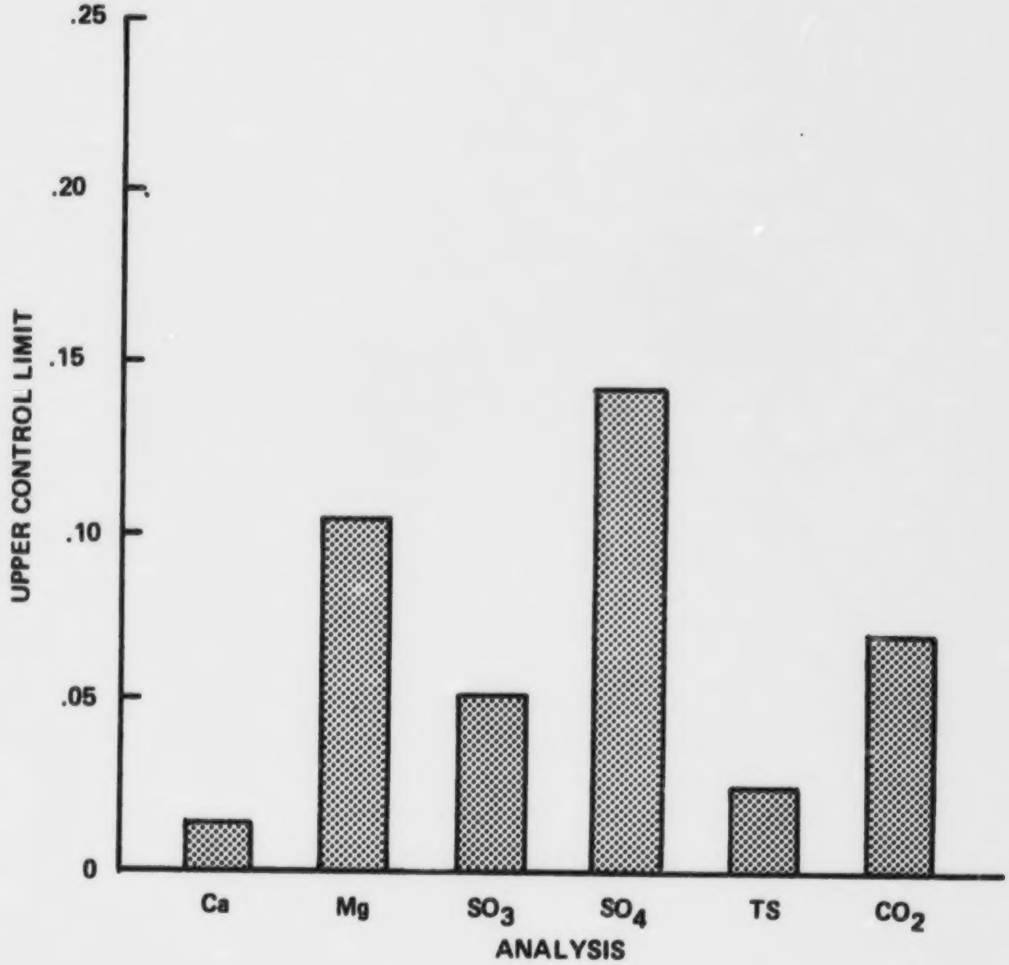


FIGURE K-3

MODIFIED SHEWHART
PRECISION CONTROL CHART
FOR SOLID SULFATE ANALYSES

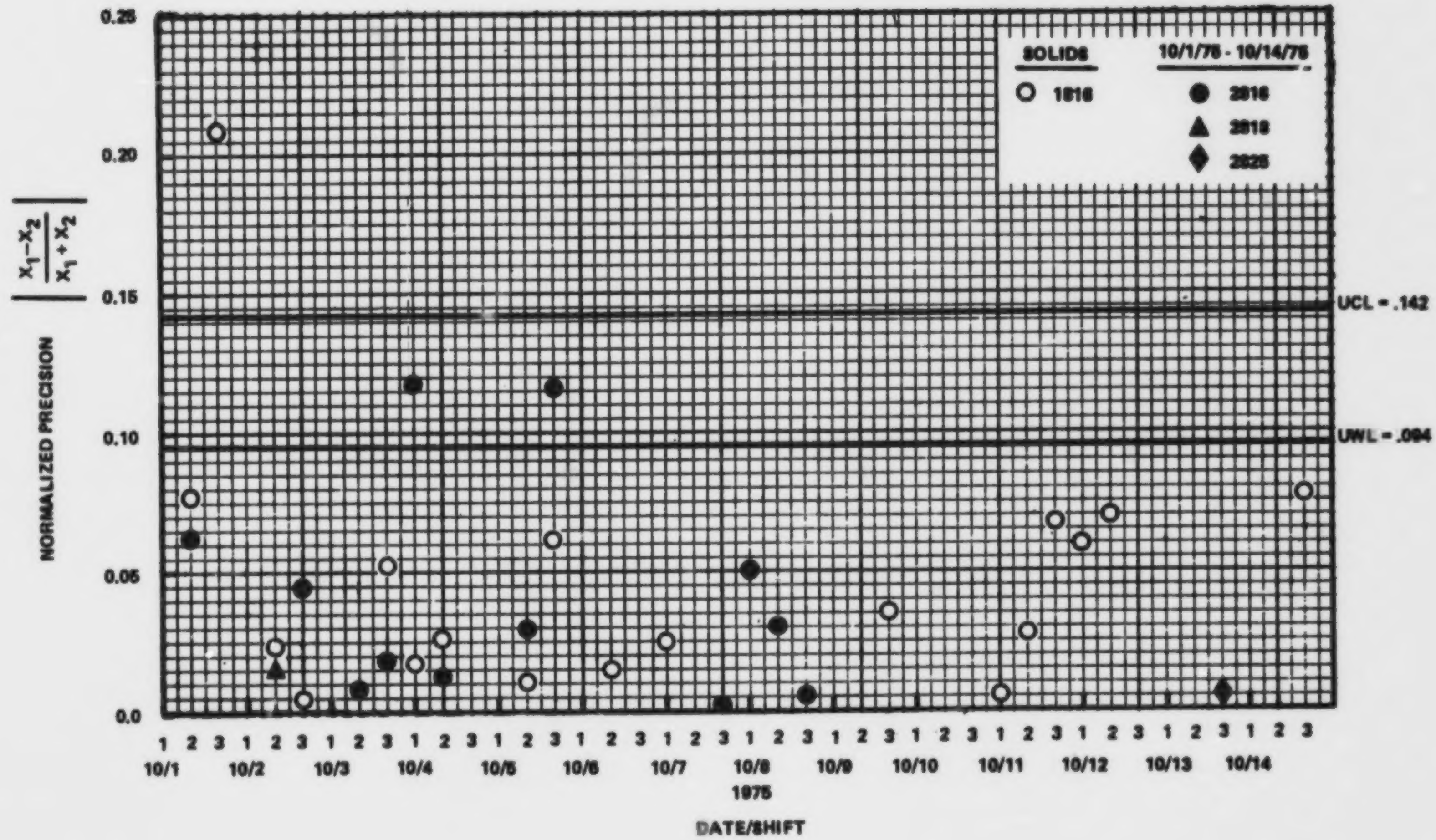
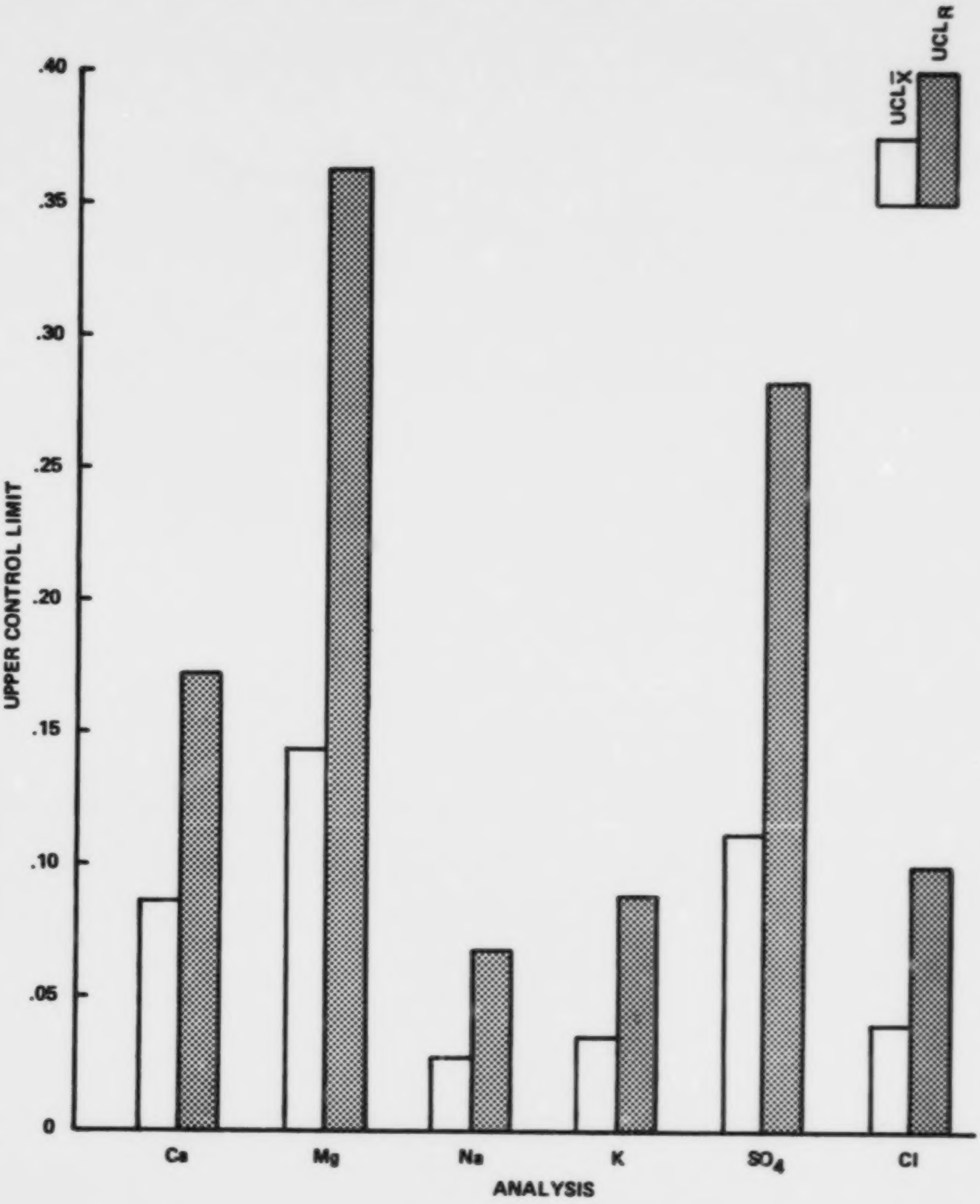


FIGURE K-4

UPPER CONTROL LIMITS (UCL) FOR LIQUID ANALYSIS ACCURACY



Appendix L

THIRD TVA INTERIM REPORT OF CORROSION STUDIES: EPA ALKALI SCRUBBING TEST FACILITY

by

G. L. Crow
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March 1976

EPA ALKALI-SCRUBBING TEST FACILITY—SHAWNEE POWER PLANT

THIRD INTERIM REPORT OF CORROSION STUDIES

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Summary and Conclusions

The first and second interim reports of corrosion tests conducted at the EPA alkali-scrubbing test facility at the Shawnee Power Plant were released in October 1973 and May 1974, respectively. These reports covered tests conducted in the venturi, the Turbulent Contact Absorber (TCA), and the marble-bed scrubber systems during the periods August 1972 to February 1973 and June to September 1973, respectively.

The current report gives results of the third series of tests which is the longest test period to date, approximately 1-1/2 years. Tests in this series were conducted only in the venturi and in the TCA scrubber systems during the period October 1973 through April 1975. (The marble-bed scrubber has been idle since July 11, 1973.) Materials that were attacked severely at some locations in the earlier tests were eliminated and a few alloys not used in the previous tests were included in the third series. Because of this, a comparison of results from the current tests with those from the previous tests is rather vague. Disk-type specimens of 27 alloys were tested in the third series. The number of specimens used ranged from 1 of Type 446 stainless steel to 26 of Type 316L stainless steel. Because of this, a realistic comparison of their corrosion resistance could not be made. However, 20 to 26 specimens were tested of each of eight alloys. The comparative resistance of the eight alloys based on the decreasing occurrence of negligible corrosion rates is as follows:

Alloys	Number of tests in which corrosion was negligible
1. Hastelloy C-276	14 of 22
2. Inconel 625	12 of 22
3. Carpenter 20Cb-3	9 of 22
4. Incoloy 825	8 of 21
5. Type 316L	3 of 26
6. Type 201	5 of 23
7. (Monel 400	1 of 20
(Hastelloy B	1 of 20

Several other alloys showed promise but were not tested at enough locations to make a reasonable comparison. Twenty of the twenty-seven alloys tested showed negligible attack at one or more test locations. At other test locations the corrosion rates ranged from < 1 to > 872 mils per year. In general, corrosion of specimens in the third series of tests was less severe than in the first and second series. The fourth series of tests now in progress at Shawnee will give more information on some of these alloys.

Hastelloy C-276 and Inconel 625 continued to show good resistance to corrosion at all test locations. Haynes 6B had low rates (some negligible) in 14 of 15 tests. Corrosion of Type 316L stainless steel was negligible to 1 mil per year in 13 tests and 21 mils in an erosion-corrosion test; however, crevice and/or pitting attack occurred in 11 tests. Type 317 did not appear to be superior to Type 316L which is definitely superior to Type 304L in the lime/limestone scrubber service. Nitronic 50 (formerly Armco 22-13-5) experienced localized attack which had not occurred in earlier tests of shorter duration. In this report where penetration by crevice corrosion and/or pitting is more prominent than general corrosion, low corrosion rates determined by weight loss are omitted.

One specimen (strip type) each of nine alloys was tested on the bottom of the TCA effluent hold tank (EHT) to evaluate these materials for resistance to erosion. A tightly adhering, deposited coating on the specimens showed that erosion of the tank bottom is not a problem. Corrosion was negligible for Haynes 6B, Inconel 702, Incoloy 800, Incoloy 825, and Type 316 stainless steel. The four other alloys suffered pitting and/or crevice corrosion.

The Type 316 stainless steel guides below the adjustable plug in the venturi had worn to depths of 0.5 to 1.5 inches. Test bars of Type 201 stainless steel and of Inconel 625 mounted on the guides failed in less than 90 days with penetration rates > 0.5 inch per year. Specimens of Type 316 stainless steel pipe fitted to shield the guides failed with wear rates of 1.5 to 2.5 inches per year.

Inlet stack gas, after being humidified with spray water, attacked stainless steel ducts and nozzles as follows: slight erosion of bare duct surfaces; concentration cell-type corrosion (pitting and crevice) of surfaces underlying deposits; and severe corrosion and erosion of surfaces subjected to impingement. In general, the neoprene-lined towers and tanks were in good condition. However, in the venturi scrubbing system minor repair was required for the neoprene lining in the flooded elbow and the neoprene-covered blades of the agitator in the EHT. Other neoprene-coated agitators showed moderate wear. Only a few joints of neoprene-lined piping were opened for inspection. One 4-inch pipe ell had blisters in the lining. It is not known whether the lining was defective or if the damage was due to operating conditions. At the time of the current inspection, the slurry circulating pumps had been reassembled in preparation for subsequent operation. However, the components that had been replaced in pump G-201 were available for inspection. The liner on both the suction and the seal sides was worn badly, and the covering on the impeller was worn and damaged from impact with circulating debris. These components had been in service 14,000 operating hours in the TCA system.

The Type 316L bull nozzle that discharged lime-scrubbing process slurry into the venturi failed with a penetration rate of 185 mils per year. In the towers of the two systems, pitting and crevice corrosion were common on Types 304 and 316 stainless steel removable parts; this occurred in stagnant areas (under deposits of solids). Movement of mobile packing (hollow plastic spheres) caused slight erosion of the 3/8-inch-diameter grid rods in the TCA tower.

Severe corrosion occurred on some areas of chevron-type mist eliminators of Type 316L stainless steel. Pitting occurred under deposits of solids; the attack was accelerated in the closed-loop system by concentration of chloride and sulfur compounds. Continuous or frequent washing of the mist eliminator with makeup water reduced corrosion of the unit.

Stellite alloy No. 6 nozzles have proven to be more durable than the original stainless steel nozzles for spraying lime slurry in the venturi spray tower. After about 4200 hours of service, the four Type 316 stainless steel nozzles in the TCA tower that spray limestone slurry showed little wear of the discharge throat, but the swirl vanes had several erosion grooves.

Exhaust gas stacks of Type 316 stainless steel exposed to gas reheated to between 235° and 265°F were attacked by general corrosion and pitting. Cracking occurred in expansion joints downstream from the induced draft (I.D.) fans. General corrosion, severe cold-working of the Type 316L stainless steel during fabrication of the joints, and fatigue caused by vibration of operating equipment could have contributed to the failures. Alloy Inconel 625 and a change in design of the expansion joint should be considered for use at this location.

A small crack occurred in one shroud of the I.D. fan in the venturi scrubber system. It originated on the periphery of the shroud in the heat-affected zone of a weld and progressed about 4 inches. The cause for the crack was probably a combination of stress corrosion and fatigue from vibration.

Bondstrand downcomers to the EHT's were in good condition; downcomers of Type 316L stainless steel were pitted.

Flakeline 103 linings in the EHT's and clarifier tanks were generally in good condition. Cracks in the lining near attachments (such as baffles and weirs) to the walls in the EHT's were covered with a protective deposit of scale and those in the clarifier tanks had not changed appreciably since the last inspection.

The venturi and TCA scrubber systems had been in operation (intermittently) about 2-2/3 years in May 1975. Inspection of plant equipment at that time revealed that some areas were in good condition while other areas had deteriorated appreciably during the last 1-1/2 years of operation. As additional hours of operation accumulate, the resistance of the facility to further deterioration is important.

Program and Facilities

Program

The experimental program for removing sulfur dioxide and particulate from stack gas at the coal-fired Shawnee Power Plant is a cooperative effort of the EPA, Bechtel Corporation, and TVA. The lime/limestone - wet-scrubbing program for sulfur dioxide removal is funded and directed by EPA. The Bechtel Corporation designed the plant facility and TVA built it. TVA is operating the plant under a test program developed and directed by Bechtel. Identification and solution of corrosion and erosion problems associated with construction materials are important goals in a program for the design and evaluation of limestone - wet-scrubbing systems. At the request of EPA in 1972, the Process Engineering Branch of TVA started corrosion tests in the scrubber systems.

Plant Facility

Much of the information about plant equipment, process flow, and preparation of corrosion test specimens was given in the report on the first and second series of tests and is repeated here for convenience.

The test facility at Shawnee used in the third series of tests at the coal-fired power plant consists of two parallel scrubber systems: (1) a venturi followed by a spray tower, and (2) a TCA. Each of these systems has the capacity to treat 30,000 acfm of gas containing 1800 to 4000 ppm of sulfur dioxide and 2 to 7 grains of particulates per standard cubic foot. Figures 1 and 2 are schematic views of the venturi and the TCA scrubbing systems.

Power plant stack gas at an average temperature of 320°F (300°-350°F) flows through a 40-inch duct to each system where slurry sprays humidity and cools the gas. It then passes through lime/limestone slurry in a particular type of test scrubber for sulfur dioxide removal. Afterward, it is passed through a mist eliminator, reheated to between 235° and 265°F to vaporize any residual mist and discharged through a fan and duct to the atmosphere. Scrubber effluent is clarified to remove solids which are discarded and the liquor is then recirculated.

Some features common to both systems are described below. The 40-inch-diameter duct that conveys the flue gas at 320°F from No. 10 boiler to each scrubber is insulated. The first section of duct is made of 10-gage carbon steel, ASTM A-283; this joins a section of Type 316L stainless steel duct that contains humidification sprays and a soot blower. The shell of each scrubber tower is constructed of 1/4-inch-thick carbon steel and it has a lining of 1/4-inch-thick neoprene. Downstream from each sulfur dioxide absorber and mist eliminator unit there is a stainless steel duct, a refractory-lined reheater fired with fuel oil, an I.D. fan of Type 316L stainless steel, and a stack of Type 316 stainless steel. For liquor handling there is a slurry recirculation tank, a scrubber effluent tank, and a liquor clarification system. The EHT and the clarifier tank are made of carbon steel A-283 coated inside with Flakeline 103 which is a Bisphenol polyester resin-fiberglass coating manufactured by the Ceilcote Company. The recirculation tank, clarified water storage tank, and reslurry tank are made of carbon steel lined with neoprene.

Distinguishing features of the systems are as follows. In the venturi scrubber system shown in Figure 1, the gas is scrubbed in a venturi unit made of Type 316L stainless steel and then passed through a spray tower (afterscrubber) with a chevron-type separator in the top for removal of mist. In the TCA scrubber system, shown in Figure 2, gas is scrubbed in a mobile bed of wetted balls, some of the remaining particulate is removed in a wash tray, and mist is removed by a separator in the top of the tower. The wash tray was removed from the TCA scrubber tower at the end of the third series of tests.

Corrosion Tests

The third series of corrosion tests was conducted during the period October 24, 1973, to April 24, 1975. Specimens were installed at 10 test locations in the venturi system. Tests conducted in the TCA scrubber system consisted of two phases—A and B. Specimens were tested at 7 locations during test phase A and at 9 locations in test phese B.

Phase A included runs 525-2A through 530-2A made during the period October 24, 1973, to April 17, 1974, for a total of 2954 hours of plant operation. Fresh spools of test specimens were installed at the beginning of test phase B (runs 531-2A through 545-2A, May 10, 1974, to April 21, 1975) to show the effect that magnesium oxide in the slurry would have on corrosion of alloys. Additions of MgO were made in an attempt to maintain the slurry liquor sulfate concentration below the saturation level. After three runs (total of 1690 hours), the addition of MgO was discontinued, but it was impractical to remove specimens at that time, so they remained in the system for a total of 6456 hours. The combined exposure period of phases A and B was 9410 operating hours.

Twenty-seven alloys were tested in the third series, but all alloys were not exposed at the 26 test locations. Some alloys that showed poor resistance to attack at some locations in the first and/or second series of tests were not included at those locations in the third series. Tables I, II, and III list the alloys tested and identify the filler metal used in preparing welded specimens. Alloys not included in the first and second series of tests but added in the current tests were: Cor-Ten A, Haynes 6B, Carpenter 7-Mo, Jessop 700, AL 6X, and AL 29-4. The last three alloys listed were tested only in the exhaust gas stacks at locations below and above the I.D. fans. Stressed specimens were not included in the current tests.

Four plastic-base materials were tested only in the exhaust gas stack downstream of the reheater at which locations the gas attained temperatures higher than that recommended by the manufacturers as maximum service temperatures for their products. Therefore, the four materials failed and further discussion is not warranted except to state that these plastic-base materials are being tested in the fourth series of corrosion tests at other locations in the two scrubber systems.

Preparations of Test Specimens and Equipment

Disk-Type Specimens

Disk-type specimens, 2 inches in diameter, were prepared of 27 metals. A weld was made (according to manufacturer's recommendations) across the diameter, and after being welded, the metal was cooled slowly in still air to simulate conditions of constructing or of repairing large equipment. Whenever it was available, metal stock of 1/8-inch minimum thickness was used and the surfaces were machined smooth after welding. Some alloys available only in thinner gages could not be machined, so the weld beads were smoothed by grinding. A hole, 23/64 inch in diameter, was drilled in the center of each disk for mounting.

Wear-Bar Specimens

Wear-bar test specimens were prepared to monitor erosion-corrosion of the Type 316 stainless steel sliding guides in the venturi cone nozzle and to evaluate other alloys for use in this service. These guides are located immediately below the venturi throat where maximum gas-slurry velocities are attained. The specimens were of Type 201 stainless steel and of Inconel 625. The bars were 14 inches long by approximately 1/4-inch wide and either 1/8- or 1/4-inch thick, depending on the stock available from which the bars could be sheared. Slitted sections of 1-inch Type 316L stainless steel pipe were tested as shields for the guide bars. Also, strips cut from 1/4-inch rubber sheets were used to protect the guide bars.

Mounting Test Specimens

Spools for mounting the test specimens and also the suspension equipment for installing them in the plants were constructed mainly of Type 316 stainless steel. Bolts and nuts were annealed to remove stresses caused by cold-working in threading operations. To prevent loss of fasteners through vibration of equipment, two nuts were locked by forcing them together.

At some test locations inside plant equipment, brackets were attached as permanent fixtures by welding, and then the spools of specimens were bolted to them. In other locations, spools were fastened to existing pipe by the use of band-type clamps. In a tank, spools were suspended by means of a 1/8-inch strip or by a 3-inch pipe that was bolted to the rim at the top of the tank. Sleeves (3/8-in wall by 6 in long) of soft butyl rubber were placed around the 3-inch specimen support pipe as cushions to prevent abrasion damage to the Flakeline coating or neoprene lining on a tank wall. Also, specimens are installed through the wall of a vessel or duct by means of a 2-inch pipe coupling and a companion plug that supports the spool of specimens. No specimens were installed inside pipelines or fittings.

Figures 3 and 4 show the type of spool assemblies used for mounting the corrosion test disks. Teflon insulators were used to prevent contact of dissimilar test materials.

Each wear-bar specimen was mounted by clamping both ends to a holder which was placed on one of four sliding guides at the venturi cone nozzle. The test bars were not insulated from the Type 316 stainless steel specimen holders. Specimens of pipe were welded to the holder and those of sheet rubber were fastened with stainless steel wire.

Test Exposures, Conditions, and Procedures

The alloys tested as disk-type specimen mounted on spools are listed in Tables I, II, and III. The specimens were identified by numbers corresponding to a test location in series 1000 for the venturi scrubber system and 2000 for the TCA system as shown in Figures 1 and 2, respectively. Table IV gives the analysis of each alloy tested either as disks, wear bars, or erosion-corrosion coupons.

Plant Operation

The two scrubber systems were operated simultaneously during much of the test period. Information pertinent to the current exposure periods and to the accumulative operation time since the original starting date for the two systems follows.

Third series of corrosion tests

	Test period	Runs, inclusive	Hours accumulative Operating	Hours accumulative Idle
Venturi	3/15/74–4/24/75	602-1A/624-1A	7315	2381
TCA	10/24/73–4/21/75	525-2A/545-2A	9410	3094

Total operating time of system since starting date

	Date	Hours	(Days)
Venturi	9/5/72	13,669	(570)
TCA	9/17/72	14,237	(593)

Plant Process Materials and Deposition

The coal used at Shawnee Power Plant contained an average of 4% sulfur (2.0 to 5.5% S) and 0.2% chlorides (trace to 0.4% Cl). The compositions of inlet and outlet gas at the scrubber systems are tabulated on the following page.

Component	Stack gas[a]	Scrubbed gas
SO_2, %	0.1–0.4	0.04–0.16
CO_2, %	10–18	11–19
O_2, %	5–15	6–16
H_2O, %	8–15	9–16
Fly ash, gr/std ft^3	2–7	0.01–0.04

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[a] Taken from unit 10 ahead of mechanical dust collectors.

Temperature of the inlet stack gas from unit 10 boiler was in the range of 260° to 330°F and that of the exhaust gas after being reheated was 230° to 265°F.

Properties of liquor in the effluent and clarifier tanks of the two scrubber systems are given in Tables I, II, and III.

Table V shows analyses of deposits removed from the venturi and the TCA scrubber systems. The following tabulation shows the variation in chemical composition of solid deposited in each of the scrubber towers.

		TCA tower	
	Venturi tower	Phase A	Phase B
Period sampled:	4/30–5/21/74	1/10–1/16/74	5/21–9/9/74
No. of samples:	4	4	15
Component, % by wt.			
$CaSO_4$	31–82	36–90	40–82
$CaSO_3$	8–39	1–36	Trace–21.6
$CaCO_3$	0.3–9.6	Trace–9.1	Trace–6.4
Mg (as MgO)	0.03–0.6	0.03–0.2	0.06–6.9
$CaCl_2$	Trace–0.2	Trace–5.3	Trace–1.2
Acid insoluble	8–20	1–28	8–58

Exposed Test Specimens

Photographs were made of the spools of disk-type specimens when they were removed from the plant as shown in Figures 5 and 6. Then the specimens were cleaned and their corrosion rates and physical conditions were determined as given in Tables I through III which also contain the properties of gas and liquor at various test points.

Results of the tests of wear-bar specimens are given in the section "Specimens Tested Below Venturi."

Inspections of Plant Equipment

Equipment in the plant systems was inspected during the period May 28-31, 1975, for corrosion and erosion damage. More corrosion, wear, and other types of damage to the equipment were apparent than was noted during previous inspections, but this is to be expected as the units age. The test facility inspection engineer contributed information compiled from his observations and inspection reports throughout the test periods. Much of this information has been included in this report.

Durometer A hardness values of rubber lining on equipment and on test specimens were measured with a Shore instrument, Type A2, ASTM 2240. Unfortunately, hardness of most lined plant equipment was not determined before plant operation; so data from the rubber vendors were ordinarily used as reference values. Temperature of the atmosphere varied from 65° to 82°F as did the temperature of equipment during the plant inspection made by the authors May 28-31, 1975. A decrease in temperature would be expected to increase rubber hardness. Values for the hardness of neoprene linings in the plant equipment are summarized in Table VI. The current hardness values range from lower to higher than those accepted as original values (determined at 73°F, ASTM D2240-68). The neoprene linings showed good resistance to deterioration in some areas but repairs had been made on the lining in the flooded elbow between the venturi and the spray tower. Linings in the towers appeared to be in good condition.

Results of Plant Inspections and Corrosion Tests

In this section, plant inspections are described first for a unit followed by the results of corrosion tests conducted in the same unit. All corrosion rates were calculated on the basis of weight loss of specimens during the period of plant operation, rather than the overall exposure period. In the first and the second interim reports, a corrosion rate was determined on the basis of weight loss (negligible if very little or no weight loss was found) regardless of whether localized corrosion occurred. However, in the current report where penetration by crevice corrosion and/or pitting is more prominent, low corrosion rates determined by weight loss are omitted.

Inlet Ducts For Flue Gas

Carbon Steel Ducts: The carbon steel inlet gas ducts were in good condition. A thin rust-colored scale was noted in some areas. A sample of the scale taken near a joint was analyzed as follows:

Composition, %					
Mg as MgO	$CaSO_4$	$CaSO_3$	$CaCO_3$	$CaCl_2$	Acid insoluble
0.31	33.19	1.18	1.72	0.24	58.59

Also, small quantities of flyash had been deposited in the ducts where the gas flow changed directions but this caused no apparent problem.

Stainless Steel Ducts: A Type 316L stainless steel section of the duct is located between the carbon steel inlet gas duct and the scrubber unit of each system. The humidification sprays are located in the stainless steel section of the duct. The sprays in the duct to the TCA scrubber system were not used during the current test period; those in the gas duct to the venturi system were used to cool the gas for protection of the neoprene lining downstream only when the tangential sprays to the venturi failed to operate. The stainless steel ducts were in good condition, and they were clean from impact of flyash. Pits that formed under deposits of solids when the sprays were used in previous tests, apparently did not increase in depth during the current tests.

The soot blowers were in good condition and were performing satisfactorily on an operating schedule of blowing once per day for cleaning the ducts during the latter part of the corrosion tests. Prior to this schedule, the soot blower had been operated once per shift. In the TCA system, the stainless steel duct in the immediate area of the soot blower showed little or no erosion or corrosion. However, the walls of the duct near the entrance to the scrubber tower were pitted to depths of 22 to 60 mils. The pitting occurred slightly downstream of the slurry cooling sprays (three nozzles) where the first wetting of the flue gas occurred. Solids were deposited on the duct walls in this area, but the deposits were removed periodically by the soot blower.

The three spray nozzles (Bete ST32FCN) were of Type 316 stainless steel. The diffuser of one nozzle was plugged; one was pitted; and the other was worn but not pitted at the end of the test period. A diffuser of Type 316 stainless steel has a life of about 3000 operating hours. Also, the stainless steel support rod for the coiled temperature sensory probe (TE-2007 located a short distance from the sprays) was pitted severely.

Specimens Tested In Inlet Gas Ducts: The inlet flue gas to the venturi system entered the stainless steel duct at 275° to 330°F and that to the TCA system at 260° to 310°F. Since the use of humidification sprays in the inlet flue gas ducts has been practically abandoned, little corrosion of the test specimens at locations 1002 and 2002 occurred as compared with that of earlier tests during which time the humidification sprays were used. In the duct to the venturi system, the rates were 1 mil per year or less with shallow pitting of some alloys except for red brass and Cor-Ten B which had rates of 6 and 9 mils, respectively (Test location 1002; see Fig. 1 and Table I).

In the TCA flue gas inlet duct, the greatest rates were for red brass and Cor-Ten B, 8 and 9 mils per year for Cor-Ten B, and 26 and 3 for red brass in test phases A and B, respectively (see Tables II and III). Corrosion of the other alloys was either negligible or less than 1 mil per year with moderate localized attack of some specimens in phase A. Note that pitting did not occur in phase B (see 2002 of Table III); these were new specimens. Most of the specimens in test phase A (see 2002 of Table II) had been exposed in previous tests when the humidification sprays were used part of the time.

Venturi Unit

Stainless Steel Equipment: The Type 316L stainless steel bull nozzle that discharged lime process scrubbing slurry into the throat of the venturi was a smooth bend elbow of 5-inch Schedule 10 pipe. The nozzle failed after 265 days of operation. Figure 7 shows that failure occurred on one side rather than on the periphery of the elbow. Impingement of fly ash accounted for wear on the external surface and lime slurry on the inside. The combined attacks gave a penetration rate of 185 mils per year.

Repairs have been required on the Type 316L shell of the venturi section. These consisted mainly of rewelding joints and patching holes with stainless steel sheet. A complete inspection could not be made of the venturi internals, but the adjustable plug-and-cone unit appeared to be in fair condition as observed through openings in the top and the bottom.

Severe erosion and pitting of the guide vanes immediately below the throat of the venturi continued as was reported previously. The original four equally spaced Type 316 stainless steel bars that guide the support for the adjustable plug had eroded to the following depths in inches: north, 1-1/8; east, 1-1/2; south, 1/4; and west, 1/2. These differences in wear rates show that channeling of the flue-gas lime-slurry mixture occurs in this section; the cause for the channeling is not obvious. Some protection for the bars was provided by the installation of test bars, sacrificial wear bars, and shields of rubber. This was done to evaluate materials of construction as well as to prolong the life of the original bars. Test bars of Type 201 stainless steel and of Inconel 625 failed in less than 90 days with penetration rates > 0.5 inch per year. Sections of a 1-inch, Type 316 stainless steel pipe were fitted to shield the guide bars; these failed with wear rates of 1.5 to 2.5 inches per year. In previous tests, Haynes 6B alloy exposed on the north guide bar showed the greatest resistance to wear of any alloy tested to date—162 mils per year (see Second Interim Report of Corrosion Studies—May 1974).

The shield of 1/4-inch-thick rubber sheet failed after a very short exposure period on two of the four guide bars.

The stainless steel support shaft for the adjustable plug in the venturi was pitted to a depth of 67 mils above the guide vanes. The shroud for the support shaft was pitted and the flanges at each end of the shroud were eroded badly.

General corrosion and pitting to a depth of 20 to 30 mils deep was observed on the stainless steel shield of the access door below the venturi (test location 1011). The attack was greatest on the periphery of the shield.

Flooded Elbow: Minor mechanical damage had occurred to the neoprene lining in the area of the flooded elbow. Also, blisters about 5/16 inch in diameter were noted on the wall above the pool of water. The surface of a blister could be broken easily leaving a smooth hemispherical pit. The blistering might have resulted from overheating during momentary loss of spray to the venturi and before the humidification sprays upstream were activated to cool the inlet flue gas.

The neoprene-lined duct between the venturi and the spray tower had required repair since completion of the second series of corrosion tests. During the outage in May, a 7- by 16-inch section of the liner was replaced overhead in the duct because of sagging. New rubber (not identified) with a Durometer A hardness of 68° at 73°F was used for the patch. Small areas of the lining that failed earlier during the current test period had been repaired by application of Plyobond, and epoxy-base cement. The Plyobond hardens upon curing, and it has shown good resistance to operating conditions encountered in the duct. The remainder of the neoprene lining originally installed in the duct appears to be in good condition; it had a hardness of 56 determined at 73°F.

The stainless steel thermocouple probe in the flooded elbow near the entrance to the spray tower was pitted to depths as great as 65 mils.

Specimens Tested Below Venturi: The specimens were installed directly below the venturi as shown at location 1011 of Figure 1. Exposure conditions are more severe at this test location than for all others in the two scrubber systems. The stack gas containing flyash, carbon dioxide, oxygen, and sulfur dioxide at 275° to 330°F is humidified by lime process scrubbing slurry as they mix and pass through the venturi at a high velocity. Erosion and corrosion are both important factors in the test at location 1011. Due to the high erosion-corrosion rate, the spool containing the test specimens had partially failed after 4179 hours of operation. Two specimens, one each of Cor-Ten B and Type 446 stainless steel, were destroyed.

The first spool of specimens was replaced by another for the remainder of the third series of corrosion tests. Makeup of the second spool was not identical to the first; however, both contained several common specimens. After the second spool of specimens was installed, the unit was operated 3136 hours, this completed the third series of tests. In reporting the results for the two spools that were exposed at test location 1011, the higher rate is given in the case of common specimens (see Table I). Penetration rates, on the basis of weight loss, ranged from 2 mils per year for Haynes 6B alloy to > 872 for Cor-Ten B. The alloys that had penetration rates of < 20 mils per year listed in the order of increasing attack were: Haynes 6B, Hastelloy C-276, Inconel 625, Nitronic 50, Incoloy 825, E-Brite 26-1, and Type 317 stainless steel. The rate for Type 316 was 21 mils per year. Five alloys were pitted; the maximum depth of pits ranged from 5 mils for Nitronic 50 to 40 mils for Incoloy 800. Each specimen that was pitted also had crevice corrosion except for that of alloy Nitronic 50.

The specimens exposed at location 1011 remained clean throughout the test. Severe erosion of the Teflon insulators and of the spacer rods was common to both spools.

Scrubber Towers

Neoprene Lining, Hardware, and Spheres: The neoprene linings on the walls of the venturi and the TCA scrubber towers appeared to be in good condition; no changes of importance had occurred since the inspection prior to the second interim report. Impingement of slurry from sprays had caused minute erosion in a few small areas. Also, slight mechanical damage, possibly due to impact when changing the internal components, had occurred in a few areas mainly in or near manways. The original Durometer A hardness (taken from the vendor's data) of the neoprene liners was 60 to 65. The current range of hardness values of the lining in the venturi and the TCA towers were 42 to 60 and 44 to 56, respectively. All measurements were not made at the same temperature (range was 65°-74°F) because of weather changes. The hardness of the neoprene is expected to increase with a decrease in temperature.

In general, the various pieces of stainless steel hardware, such as manway deflector plates, header pipes for water and slurry, temperature probes, overflow weirs, sampling equipment and suspension brackets were pitted in both systems. Spot checks for alloy identification were made on some of the hardware in the venturi system. This information revealed that equipment of Type 304 stainless steel was less resistant to pitting than that of Type 316. The pits were more numerous and about twice as deep on the Type 304 components. Figure 8 shows the comparative attack of Type 304 and Type 316 stainless steel components joined by welding in a common slurry header in the venturi spray tower. Also, Figure 9 shows pitting at the bottom of a Type 316 weir box outlet in the TCA tower.

Carbon steel clamps and brackets that fasten and support headers for the slurry sprays were broken probably due to stress-corrosion cracking (see Fig. 10).

Many of the spray nozzles in the venturi system were in excellent condition, a few were pitted, and others showed moderate wear. The slurry contained about 8% solids. Accelerated attack of threaded components caused loosening of some nozzles. The life of the components could be increased greatly by fully annealing after threading to remove the effect of cold-working. Bete nozzles of Stellite No. 6 alloy have proven to be more durable than the original stainless steel nozzles for spraying lime slurry in the venturi spray tower. In the TCA tower, four Type 316 stainless steel nozzles (Spraco No. 1969 full-cone free-flowing) were used to spray limestone slurry that contained about 15% solids. After about 4200 hours of service, the discharge throat (about 2.9-in dia.) of the nozzles showed little if any wear, but the swirl vanes had several erosion grooves.

The original stainless steel wire grids which showed pitting and crevice corrosion in the TCA tower were replaced October 24, 1973, with 3/8-inch-diameter rods of Type 316 stainless steel. By May 1975, the rod grids had been in service about 9100 operating hours. Slight pitting was noted on some rods and crevice corrosion occurred where the rubber grommets on the ends made contact with the rods. Movement of TCA spheres wore a flat surface in two planes on the top half of the grid rods. A decrease in diameter of 8 to 15 mils was measured on the flat surfaces except on the uppermost (fourth) grid which did not support spheres.

Two types of spheres were used during the corrosion test period. High-density polyethylene spheres (HDPE, 6 gram) were used on the bottom grid, and many of them failed by developing holes during 1041 hours of service. After the walls wore thin, these spheres often formed single or double dimples. The beds on the second and third grids were of thermoplastic rubber (TPR, 5-gram) spheres. Some of the TPR spheres were used 3784 hours without failure, but others split in half at the mold line after short periods of service. The dimpled and the half spheres often passed between the grid bars to a lower level. Strainers were installed in the slurry lines to prevent the failed spheres from plugging spray nozzles and/or damaging other equipment in the system.

The original mist eliminators in both the venturi and the TCA scrubber systems were constructed of Type 316L stainless steel; the vanes were of 16-gage sheet (about 0.062-in thick).

The mist eliminator in the venturi system was a horizontal, three-vane, open-pass unit that remained in service for 8700 operating hours. It was corroded badly. The vanes were perforated in some areas at penetration rates > 62 mils per year. Subsequently, a four-vane closed-pass, conical-type mist eliminator with a 30-degree slope was installed in the venturi tower. It was used only 1219 hours during which time the vanes were pitted to depths up to 45 mils. Plugging of the bottom with solids was the major problem with the conical-type unit.

A new mist eliminator of the same design as the first, had been in service in the venturi scrubber tower 823 hours at the time of the present outage. No damage of the unit due to corrosion was noted. A system of spraying the unit by automatically controlled cycles apparently has improved the efficiency of the mist eliminator.

The original mist eliminator in the TCA system was in service from the startup in August 1972 until the outage in April 1975. The estimated total hours of service for this unit is 14,000. It is a 6-pass, closed-path, chevron-type horizontal unit. Some vanes were in excellent condition while others had numerous pits and perforations. Where failures occurred, the rates of penetration were > 34 mils per year.

During the outage, a two-stage, fiberglass-reinforced polyester (FRP) mist eliminator was installed in the TCA tower. The vanes were about 0.060-inch thick and the spacer plates were 0.120-inch thick. Only the lower stage was provided with oversprays and undersprays.

Specimens Tested in Towers: The locations of the test specimens in the scrubber towers are shown in Figures 1 and 2. The test conditions and corrosion rates are given in Tables I, II, and III.

Figures 4 and 5 show the spools of specimens as they appeared when the tests were completed. The test medium at each location in the two towers and the approximate amount of solids deposited on the spool at the end of the test are given below.

System	Test location No.	Test medium	Amount of solids on spool
Venturi	1006	Gas and liquor	None (clean)
	1005	Gas and liquor	Partially covered
	1004	Gas and droplets	Covered
TCA (phase A)	2006	Gas and liquor	None (clean)
	2005	Gas and droplets	Partially covered
	2004	Gas and mist	Lightly covered
TCA (phase B)	2006	Gas and liquor	None (clean)
	2005	Gas and droplets	Partially covered
	2004	Gas and mist	None (clean)

In the venturi tower, the specimens tested at location 1006 (the lowest test location) had the lowest corrosion rates—less than 1 to 55 mils per year; and those at the highest elevation (location 1004) had the widest range of rates—negligible to > 82 mils per year. Carpenter 20Cb-3, Hastelloy C-276, Haynes 6B, Inconel 625, and Type 316L had rates of < 1 mil per year on the basis of weight loss at the three test locations. Pitting and/or crevice corrosion occurred on 20 of the 48 specimens tested in the venturi tower.

In the TCA tower, a spool of specimens was exposed at each of three locations, 2006, 2005, and 2004 identified in the order of the lowest to the highest test locations; their positions in the tower are shown in Figure 2. As stated previously, the third series of tests in the TCA system consisted of two phases, A and B.

The results for tests in phase A are given in Table II, and for phase B in Table III. With one exception which will be discussed later, there was little difference in corrosion rates of an alloy tested at a given location in both phase A and phase B. Usually the greatest general corrosion, on the basis of weight loss, occurred at the test location of highest elevation (2004). However, this was not necessarily true in cases of localized corrosion.

The exception mentioned above was at test location 2006 in phase B where the specimens were damaged due to abrasion of the periphery by movement of the plastic spheres. Corrosion rates could not be determined for these specimens but information on crevice corrosion and pitting is given in Table III. Guard rods were attached on the spool to prevent contact of the spheres with the specimens in the test at location 2006 of phase A, but the guard rods were inadvertently left off the spool in phase B.

To generalize on both phases of the tests in the TCA tower, the corrosion rates ranged from negligible for several alloys to > 57 mils per year for Cor-Ten B (specimen was consumed). The alloys with corrosion rates of 1 mil per year or less were: Carpenter 20Cb-3, Crucible 26-1, Hastelloy C-276, Haynes 6B, Inconel 625, Type 316L, and Type 317 stainless steel. Some form of localized attack occurred on 57% of the specimens tested in the tower. These specimens are identified in Tables II and III.

Exhaust Gas System

Equipment for Reheating Scrubbed Gases: The inside area of the Type 316L stainless steel stack between the venturi afterscrubber and the reheater was pitted. About 18 inches above the uppermost neoprene lining (or about 4 feet below the old inline reheater), pitting had occurred to depths up to 37 mils. In the TCA system, the area between the top of the scrubber tower and the reheater was not accessible for inspection because the new plastic mist eliminator had been installed.

During operation, the scrubbed flue gases were reheated to 235° to 265°F by oil-fired reheaters. The original reheaters were the inline-type manufactured by Hauck. Before the third series of corrosion tests was begun, an external reheater manufactured by Bloom Engineering Company was installed in the venturi scrubbing system. Hot combustion gases from the Bloom heater discharge into the cavity of the old Hauck unit for mixing with and reheating of the scrubbed gas. The monolithic refractory lining in the old inline unit was in good condition. However, the area of the lining onto which the hot gases from the new Bloom unit impinged at a right angle, had been repaired once after the Bloom unit was put in operation. Also, moderate chemical attack had occurred due to acid in the condensate that drained from the Type 316 stainless steel stack onto the lining at the top of the unit.

In the Bloom unit, the refractory lining and the insulating materials have a combined thickness of 7 inches in the combustion chamber and 14 inches in the discharge zone. The innermost monolithic lining was discolored yellow-brown and was cracked to depths of up to about 2 inches. Although the lining was in good working condition, the discolored, cracked material was removed by chipping and was replaced with Kruzite, also a monolithic refractory produced by A. P. Green Company who recommends it for service temperatures to 3200°F.

Operation of the Bloom reheater was reported to have been much better than that of the inline reheater previously used in the venturi system. Frequent flameouts had made operation difficult with the inline Hauck reheater. However, in the current inspection, there were more deposits of flyash, oil, etc., in the venturi stack than in the TCA stack.

The Hauck inline reheater was used in the TCA system throughout the third series of corrosion tests. During the May 1975 outage, a Bloom external reheater identical to the one in the venturi scrubber system was installed in the TCA system. The 3/16-inch-thick carbon steel shell of the old Hauck unit was stripped to permit relining. In general, the shell was in good condition. Only moderate scaling had occurred inside except around the burners where the insulation had failed.

During previous tests, the frequency of flameouts in the original inline oil-fired reheaters was reduced by the use of burner nozzles with better atomizing characteristics and by the installation of a sleeve 40 inches in diameter by 4 feet tall that improved combustion of the oil before the scrubbed flue gas mixed with the hot combustion gases. Prior to this installation, the scrubbed gas quenched the flames. The first sleeve installed was of 10-gage Type 304 stainless steel because a heat-resistant alloy was not immediately available; it had a service life of 3135 hours. It was replaced by a 1/4-inch-thick sleeve of Type 310 stainless steel. Even though the sleeve warped during 7930 hours of operation, its use was continued considerably longer. During the third series of corrosion tests in the TCA system, frequent cleaning of the burner nozzles and ending steam sparging for cleaning the mist eliminator further reduced the frequency of reheater flameouts. Consequently, the deposition of soot in the stack and fan was reduced; also, as a result of fewer flameouts, less oil was deposited on the wall of the stack. In fact, no oil was found in the stack above the reheater of the TCA system. This indicates that good combustion was obtained in the Hauck reheater during the latter part of the corrosion test period. There was a deposit of dry solid ranging from 1/16- to 1-inch thick on the inside walls of the stack.

Pitting and general corrosion occurred on the inside wall of the Type 316 stainless steel stacks. Because the Bloom reheater for the TCA system was being installed and tested, only a limited inspection could be made of areas above the reheater. However, in the stack of the venturi system, pitting to depths of as much as 78 mils had occurred about 6 inches above the refractory of the old inline reheater. About 2 feet further up the stack pits were 30 mils deep. Apparently, the depth of pits decreases as the elevation of the cylindrical sections of the stacks increases.

Transition sections of duct (cylindrical to rectangular) connect the inlet and outlet of the I.D. fan to the stacks. The inlet section (below the fan) divides the gas stream before it enters the fan through two parallel sets of dampers. Green liquid dripping from the divider below the dampers indicates that the Type 316 stainless steel had been corroded at that elevation or above. Pits as deep as 13 mils were measured on the plates in this area.

I.D. Fans: During the corrosion test period, a crack developed on the east shroud of the Type 316L stainless steel I.D. fan in the venturi system. The crack originated on the periphery of the shroud in the heat-affected zone of a weld that joined a blade to the shroud. It progressed parallel with the weld 2-1/2 inches, then deviated gradually from the weld for a total length of about 4 inches as shown in Figure 11. The crack was repaired by grinding out and welding from both sides. The filler metal was Type 347 and/or Type 316L stainless steel.

The average thickness of the fan blades was 0.270 inch; however, the values ranged from 0.247 to 0.282 inch. Apparently, the blades in the I.D. fan of the venturi system were cut from plates of different thickness. The current measurements were in fair agreement with those made when the first series of tests was completed. Four of these blades were bent slightly on the periphery; one blade had two bends. Some of these bends have occurred since the first tests were completed. Reportedly, a thermocouple weld fell from the stack above while the fan was in operation.

The following observations were noted on the I.D. fan for the TCA system:

- A small bend on each of three blades
- A small crack on the periphery of the west shroud near a counterweight attached by welding to balance the fan
- A small cut on the periphery of one blade
- Pits on the periphery of a shroud near one blade

In the future, consideration should be given to welding counterweights on the spider (center rib of blade) rather than on the shroud to balance the I.D. fan. The thickness of blades in the TCA fan ranged from 0.260 to 0.275 (avg. 0.269) inch.

The liners in the fans are spot welded only. Continuous welds would reduce the extent of vibration of the liners and thereby decrease the possibility of failure due to fatigue.

Expansion Joints: Repairs have been required on the expansion joints above the I.D. fan in both the venturi and TCA scrubber systems. Corrosion, as shown in Figure 12, is believed to be the greatest factor in damage to these joints; however, severe cold-working of the Type 316L stainless steel during fabrication and fatigue caused by vibration from operating equipment could have contributed to the failures. Small holes were plugged by spot welding. Cracks were sealed by welding a strip of metal over them.

The expansion joints are rectangular in shape with only a few corrugations to absorb changes that accompany expansion and contraction. If the design were cylindrical with a longer bellows section to absorb the changes in dimension, a longer life could be expected. Also, fully annealing the expansion joint after forming would increase its resistance to corrosion. The use of a more corrosion-resistant alloy, such as Inconel 625, in this service should be considered.

Specimens Tested in Exhaust Stacks: The Type 316 stainless steel exhaust gas stacks for both scrubber systems were insulated externally during the summer of 1974 so the minimum heat required to prevent formation of condensate in the stacks could be determined. New test locations 1014 and 2014 were provided in the stacks below the I.D. fans, and locations 1015 and 2015 above the fans in the venturi and TCA systems, respectively (Figs. 1 and 2). Corrosion test specimens were installed in the new locations in October 1974 for exposure during the remainder of the third series of tests. The corrosion tests at locations 1007 and 2007 had been in progress several months before the stacks were insulated; these tests were discontinued when the third series was completed. The test conditions at locations 1014 and 2014 (only a few feet downstream) are very similar to those at locations 1007 and 2007, respectively. The temperature of gases in these tests was usually 235° to 265°F.

Tables I, II, and III give pertinent information about exposure conditions and results of the tests. When the specimens were removed for evaluation, more solids were on the specimens in the venturi stack than on those in the TCA stack, probably because of the presence of a small amount of fuel oil in the venturi stack.

The specimens tested at location 1007 in the venturi stack were exposed during 7315 hours of operation. General corrosion rates ranged from 1 mil per year for Cupro-Nickel 70-30 and Hastelloy C-276 to 11 mils for Cor-Ten B (Table I). These and four other alloys that had intermediate rates did not show evidence of localized attack. However, seven alloys experienced crevice corrosion and/or pitting which was more severe than the low rates determined by weight loss. The depth of pits ranged from minute to 28 mils.

Tests at location 2007 in the TCA stack during phases A and B were for exposure periods of 2954 and 6456 operating hours, respectively. Corrosion was negligible on three specimens in phase A and on seven in phase B (Tables II and III). In the two test phases combined, 11 specimens were corroded at rates of < 1 to 3 mils per year and 11 others were attacked by crevice corrosion and/or pitting. For Type 316L stainless steel, attack of one specimen was negligible, but crevice corrosion and shallow pitting occurred on the other.

After the stacks were insulated, the test period for specimens at locations 1014 and 1015 in the venturi system was 4174 operating hours and for those at 2014 and 2015 in the TCA system, 3892 hours (the latter part of phase B). In the venturi stack, corrosion rates at location 1014 (below fan) ranged from 1 to 6 mils per year and at 1015 (above fan), the rates were 1 to 2 mils (Table I) with no evidence of localized attack. Cor-Ten A had rates of 6 and 2 mils per year and mild steel had rates of 5 and 2 mils per year in the tests below and above the fan, respectively.

Corrosion was even less on specimens at the new test locations in the TCA stack; the rates ranged from negligible for most alloys to 1 mil per year for Cor-Ten A and mild steel. Crevice corrosion occurred on stainless steel Type 201, 216, and 316L at test location 2015 (above fan) but not at location 2014.

In general, the data indicate a slight decrease in corrosion of specimens in the stacks after the insulation was applied.

U-shaped stressed specimens of six alloys were installed recently in the inlet gas cavity of each fan in an effort to identify the cause of cracking of the I.D. fan and expansion joints. If static stresses are detrimental in this environment, the U-shaped stressed specimens could reveal this. However, if cyclic stresses caused by vibration are the main cause, the U-shaped specimens now being tested will not reveal this. Earlier in the test program, stressed specimens had been exposed at several locations, but none were installed in the housing of the I.D. fans. None of the stressed specimens failed in the earlier tests, but those tests were for comparatively short periods.

Tanks

Effluent Hold Tanks: An EHT 20 feet in diameter and 21 feet tall is located directly under each scrubber tower: D-101 for the venturi and D-201 for the TCA. The shells are made of A-283 carbon steel coated inside (80 mils minimum thickness) with Flakeline 103 manufactured by the Ceilcote Company. This coating is a Bisphenol-A type of polyester resin filled with flake glass (25-35%).

In general, the Flakeline 103 coating on the baffles and tank walls appeared to be in good condition in both EHT's. The small cracks with iron rust bleeding through at the junction of baffles with the walls which were noted in previous inspections were not visible currently due to a deposit of scale which apparently provides protection.

In the venturi EHT, the Flakeline 103 coating was removed from a small area of the wall (north side) near the tank bottom for installation of a stilling well for a level-sensing element. Near the tank top, a 16-inch-diameter pipe had been installed from the scrubber downcomer through the walls of the tank on the east and south sides. The bare steel in the areas affected at these installations was coated with blue epoxy paint. There is concern that undercutting of the fractured Flakeline coating might cause "flaking off" of the coating. An application of new Flakeline 103 in the affected area would demonstrate the repairability of the old coating. To date, no onsite repairs have been made using the Flakeline materials. Most repairs have been made with epoxy paint.

The 8-inch-diameter pipe of Bondstrand (FRP, resin not identified) supplied by Ameron, Brea, California, in each EHT was in good condition. The pipe in D-101 for the venturi system has never been used for conveying slurry but has served as a guide tube for measuring liquid level. The Type 316L stainless steel downcomers (4-ft dia.) were pitted under the tightly adhering, hard scale. A 4-inch carbon steel pipe that extends from the top to near the bottom on the west side of D-201 (TCA system) for returning wash tray liquor is corroded severely; it had been in this service about 1-1/2 years.

The neoprene-covered agitator blades in D-201 are in good condition; they show moderate wear on the leading edges and some damage due to impact with foreign materials. During the test period, the agitator had been lowered to within 2 feet of the tank bottom. The agitator blades in D-101 of the venturi system have required appreciable repairs. The stabilizer on each of two blades broke; these were repaired by welding the broken pieces in place and then coating the metal core with Epoxylite No. 203. Some erosion of the hard coating has occurred, but it appears to resist abrasion fairly well. Another area of one repaired blade had a large blister on the covering. The neoprene covering on the third blade of the agitator had failed at the bottom corner on the end. This damage appeared to be recent (corrosion of steel core was not apparent) and was probably due to impact by a hard object. The hardness of the neoprene coverings on the agitators is given in Table VI; these values have not changed appreciably from the original values.

Specimens Tested in EHT's: A spool of corrosion test specimens was mounted in the EHT of the venturi and the TCA systems about 7 feet and 2 feet above the tank bottoms, respectively. Figures 1 and 2 show the test location, and Figures 4 and 5 are photographs of the spools identified by test location numbers. Tables I, II, and III give the test results. The corrosion rate in the venturi EHT which handled lime slurry that usually contained about 8% (range 7 to 16%) solids with pH 4.5 to 6.3 was negligible for eight alloys, about 1 mil per year for Cor-Ten A and Cupro-Nickel 70-30, and localized attack occurred on five specimens. Crevices were not measured, but pits penetrated in depth from minute to 15 mils during the test periods of 7315 operating hours. The alloys that had negligible corrosion rates were: Carpenter 20Cb-3, Hastelloy C-276, Haynes 6B, Incoloy 825, Incoloy 625, Nitronic 50, and Type 316L stainless steel. The list is practically the same for materials that had negligible corrosion rates in the TCA EHT, although the spools were not identical.

For the specimens exposed in the TCA EHT in test phase A, corrosion was negligible for six alloys; < 1 mil per year for red brass, Cupro-Nickel 70-30, and Monel 400; 2 mils for Cor-Ten B; and localized attack (crevice and/or pitting) occurred on seven specimens. Five of these had only minute pits, but some pits on Type 201 stainless steel were 8 mils deep. In test phase B, 12 specimens had negligible corrosion rates, four had rates of about 1 mil per year, only one (USS 18-18-2) showed crevice corrosion, and no pitting occurred.

The reason for less localized corrosion in test phase B than in phase A is not obvious. The exposure period (operating time) for test phase B was more than twice that for phase A. Long exposure periods are desired for identifying the susceptibility of metals to pitting. Therefore, it appears that the chemical conditions and/or other factors affecting the limestone slurry in the TCA EHT during test phase A (runs 525-2A through 530-2A) were different from those during test phase B (runs 531-2A through 545-2A). Magnesium oxide was added to the slurry during 26% of the exposure period for test phase B.

Limestone slurry was used in both test phases A and B. The temperature and pH of the slurries in the two tanks were comparable. The ionic composition as tabulated below shows that the $Cl^=$ and Ca^{++} ionic concentrations were highest in the venturi tank, and the $SO_3^=$, $CO_3^=$, $SO_4^=$, and Mg^{++} ionic concentrations were highest in the TCA tank during phase B which was the least corrosive.

Ionic Composition of Effluent in System, ppm

		TCA	
Ion	Venturi	Phase A	Phase B
$SO_3^=$	35-1050	30-290	70-5000
$CO_3^=$	5-200	40-380	30-1000
$SO_4^=$	300-1600	200-2700	300-39,000
Ca^{++}	100-4400	1100-2600	100-2000
Mg^{++}	50-6400	200-500	260-12,000
Na^+	25-90	30-120	35-60
K^+	50-330	50-520	40-115
Cl^-	400-8400	1500-5000	800-4500

A comparison of the results of the three series of tests shows that corrosion rates were lower during the third series of tests than in the first or second. However, many of the less promising alloys had been eliminated during the first two series of tests.

In October 1973 a hole was discovered in the Flakeline 103 coating on the bottom of the TCA EHT and was assumed to have resulted from erosion by the limestone slurry. In order to define the severity of erosion on the tank bottom, under operating conditions, specimens of nine alloys were tested in the area that had been damaged. The specimens were approximately 1/8-inch thick by 2 inches wide by 6 inches long and were positioned in a circle on the tank bottom directly under and about 2 feet below the agitator. The specimens were mounted at a 15-degree incline to amplify the effect of erosion on a carbon steel plate placed under the agitator to protect the Flakeline floor from possible excessive erosion resulting from lowering the agitator. The bottom end of the specimen was insulated from the horizontal plate by sheet rubber and the upper end from the steel bracket and bolt with Teflon tubing and washers. A list of the alloys tested and the results of the tests after an exposure period of 392 operating days and 129 idle days are given in the following tabulation.

Alloys	Erosion-corrosion rate, mils/yr[a]	Other types of attack[b]
Haynes 6B	Negligible	None
Incoloy 800	Negligible	Negligible
Incoloy 825	Negligible	None
Inconel 600	Negligible	Minor crevice corrosion
Inconel 601	Negligible	P5, minor crevice corrosion
Inconel 702	Negligible	Negligible
Mild steel	Negligible	P6, severe crevice corrosion (50 mils)
Type 316L stainless steel	Negligible	None
USS 100	Negligible	P5, moderate crevice corrosion

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[a] Negligible indicates corrosion rates of < 0.05 mil per year; the specimens had tightly adhering deposited coating that protected them from erosion.

[b] "P" preceding a number indicates pitting during the exposure period to the depth in mils indicated by the number.

Although a tightly adhering, deposited coating on the specimens prevented erosion, four alloys did suffer localized attack. Corrosion was negligible for: Haynes 6B; Inconel 702, Incoloy 800, Incoloy 825, and Type 316 stainless steel. Minor crevice corrosion occurred on Inconel alloys 600 and 601, USS 100 showed moderate crevice corrosion and pits 5 mils deep, and mild steel had pits 6 mils deep and a crevice 50 mils deep. Apparently, the damage to the Flakeline coating on the tank bottom was not due to erosion so the tests were discontinued.

Clarifier Tanks: The clarifier tanks for both scrubber systems are 15 feet tall. The diameter of tank D-102 for the venturi system is 20 feet and that for D-202 for the TCA system is 30 feet. Each tank has a cone-shaped bottom that is positioned 3 to 5 feet above the foundation elevation. The tanks are constructed of A-283 carbon steel coated inside with Flakeline 103 and the mechanical equipment inside the clarifiers is made of Type 316L stainless steel.

In general, the Flakeline 103 coating in the tanks was in good condition. Rust bleeding through hairline cracks in the coating at the junction of the effluent launder with tank walls had changed little since the second series of tests. This was true also at the junction of the walls with the bottom in D-102, but the corresponding area in D-202 had been sealed with an epoxy coating. The scratches through the top coat on the walls of D-202 inflicted by the stainless steel plows (noticed Sept. 1973) have resisted corrosion equally as well as the undisturbed areas of Flakeline 103.

The paint underneath the flange at the top of both tanks failed in the area immediately above the overflow box for clarified liquor. Also, outside and about 2 feet below the top of tank D-202, the paint had blistered in a horizontal band. Apparently, this is a welded joint that was painted without sandblasting.

Failure in April 1974 (Run 530-2A) of the main shaft that drives the plows in D-202 apparently occurred during a startup following an idle period that allowed heavy deposits of solids to overload the equipment. The shaft was replaced with the one from clarifier tank D-302 of the marble-bed system which was not in use. The stainless steel mechanical equipment in both clarifier units appeared to be in good condition.

Specimens Tested in Clarifier Tanks: A spool of corrosion test specimens was suspended in the slurry 5 feet below the launder in each clarifier tank, D-102 and D-202. These tanks are not shown in Figures 1 and 2. Items 1013 and 2013 in Figures 4 and 5 are photographs of specimens after exposure. Tables I through III give the corrosion data.

The corrosion rates were negligible or < 1 mil per year for most of the alloys tested in the clarifier tanks. The highest rate was 3 mils per year for Cor-Ten B in the TCA system during test phase A. The following alloys were attacked by crevice corrosion and/or pitting: Cor-Ten B, Hastelloy B, Type 201, and USS 18-18-2. Alloy USS 18-18-2 had the most severe localized attack; each specimen had crevice attack and pits were 8 to 23 mils deep. Pitting and crevice corrosion had progressed less on the specimens in the TCA clarifier tank during phase A than on those during phase B or on those in the venturi clarifier tank. This was expected because the operating period was much shorter for phase A (2954 vs. 6458 and 7315 hours, respectively).

Clarified Process Water Storage Tanks: The clarified process water storage tank D-103 for the venturi system is 10 feet in diameter and 9 feet tall. The tank D-203 for the TCA system is 13 feet in diameter and 9 feet tall. Each tank has four verticle baffles welded to a shell of carbon steel and lined with 1/4 inch of neoprene. Each tank has a three-blade agitator with diameters of 14 inches in D-103 and about 42 inches in D-203. The agitators and shafts were covered with neoprene.

The neoprene lining in the D-103 tank was in good condition, but the lining in the D-203 tank contained several hard blisters in the area that was immersed when in operation. The blisters were about 3/4 inch in diameter and protruded about 3/16 inch. The agitator blades showed some evidence of wear on the leading edges, but no failures. The carbon steel pipe that discharges clarified water into D-203 was rusty.

The hardness of the neoprene tank linings and agitator covers is given in Table VI. The hardness values for the two tank linings vary less than those for the covers on the agitators, but these variations are moderate.

Reslurry Tank: Tank D-401 is used for reslurrying waste solids removed by the clarifier of both the venturi and the TCA systems. It is identical in size and construction to tank D-103 already described. The linings and agitator equipment appeared to be in good condition as viewed from the top of the tank. The hardness of the lining above the liquid level (see Table VI) was comparable with the hardness of the clarified process water storage tanks above the maximum liquid level.

Lime Slurry Preparation—Feed Tank: The lime slurry feed tank D-521 is constructed of uncoated carbon steel. Also, the two impellers (about 3 feet apart) and the shaft are of carbon steel. The tank walls and agitator components were rusty, but showed no appreciable deterioration.

Limestone Slurry Preparation—Feed Tank: The limestone slurry feed tank D-508 and the agitator with dual impellers (one about 2 inches above the bottom and the other 2 feet above the bottom) were constructed of Type 304 stainless steel. The tank and the components were in good condition.

Pumps, Neoprene-Lined Centrifugal

Liners and Covered Impeller: Neoprene-lined Centriseal pumps were used in both scrubber systems during the current test period. At the time of the inspection (May 29-31, 1975), all the pumps had been reassembled in preparation for subsequent operation; however, a casing containing a worn neoprene lining that had been replaced in pump G-201 was available for inspection. This lining and impeller were original equipment in G-201 used only in the TCA system during approximately 14,000 operating hours (Aug. 1972 to May 1976). Both the suction and the seal side liners were worn badly in the area 6 to 10 inches from the center, and the neoprene covering on the impeller was pitted and damaged from impact with circulated debris. Durometer hardness measurements of the impeller and liners (see Table VI) show that the hardness had not changed appreciably.

Packing and Sleeves: The information available on maintenance of the pumps shows that the most frequent problem is failure of packing. Pumps G-105, G-205, and G-206 each were repacked five times during October of 1974, and pumps G-105 and G-205 were repacked six times during the previous month. The shaft sleeve is of Type 304 stainless steel, the stuffing box and packing gland are of cast iron, and the packing is SEPCO ML-402 and/or 502 that consists of graphite impregnated asbestos fibers braided together by the braid-over-braid method then calendered to a square section. The reports indicate that the use of hardened sleeves increases the life of the packing. The Strum Company of West Virginia supplied Type 304 hard-faced sleeves. These were used only on small pumps.

The Second Interim Report of Corrosion Studies, May 1974, listed the pumps that had been converted from Hydroseal to Centriseal which has air instead of water for a seal. The change was made because the Hydroseal pumps added more water to the system than could be tolerated in closed-loop operation. However, greater sleeve wear resulted when using air as a seal.

Piping

Only a few joints of the rubber-lined piping were opened for inspection. One 4-inch ell located just upstream of control valve 1047 had blisters in the neoprene lining, as shown in Figure 13. Also, the pipe adjacent to the ell, both upstream and downstream, had a blister in the lining. The piping had been in service about 14,000 hours carrying lime scrubbing process slurry to the venturi bull nozzle. A small quantity (0.8 mil) of clear liquid was withdrawn from the blisters with a syringe and analyzed. Analysis of the liquid is shown below.

Calcium	113 ppm
Magnesium	688 ppm
Sodium	214 ppm
pH	5.6

Calcium, magnesium, and sodium are present in the scrubbing process slurry in moderate quantities. The relative high concentrations of magnesium and sodium in the liquid are attributed to earlier tests during which large quantities of these elements were added to the slurry. Currently, the cause is not known for blistering of the lining in the ell or whether it is occurring at mid-length in long, straight sections of pipe. Turbulence in the ell and adjacent area could be a factor. Also, there is the possibility of a defective lining in this pipe section.

Strainers

The Elliott Type R filters (flat dual filters) in the discharge lines of the G-201 and G-204 pumps were replaced by vertical-type Hayward strainers. The cast iron housing of the Elliott strainers had eroded and corroded to failure; however, the threaded copper-base shaft that extends through the unit for diverting the flow of slurry from one chamber to the other showed good resistance to attack. Also, the stainless steel baskets showed negligible attack. Two single element Hayward strainers used in parallel were installed in May 1975 to replace each dual-element Elliott strainer. The materials of construction of the Hayward strainers are: body, cast steel; trim, malleable iron; basket, Type 316 stainless steel plate 20 mils thick perforated with 3/8-inch-diameter holes; and cover gasket, neoprene.

Valves

Gate Valves: Fabri knife-gate valves were installed in the slurry line upstream and downstream from the Hayward strainers for diverting the slurry flow from one strainer to the other. The wetted part of the valves is Type 316 stainless steel; all other parts are cast or fabricated carbon steel. Since installation of the valves, problems have been reported with leakage at the O-ring seal around the valve stem. Also, leakage through the valve has occurred because a buildup of solids in the seat prevents complete closing of the knife gate.

Check Valve: The stainless steel check valve in the pipeline on the suction side of pump G-103 has been removed from the venturi system. The spring that closes the valve had failed due to erosion and the hinges were worn badly. The body of the valve was of cast stainless steel ASTM A-351, Grade CF-8M. The plate (hinged vertically at the center of the cavity) was of Type 316 stainless steel, and it seated on a neoprene ring. The check valves have not been needed, and others will probably be removed as opportunity permits.

General Information

Table VII is a compilation of data for all alloys tested in the two scrubber systems without identifying the test conditions. This table summarizes information on pitting, crevice corrosion, and general corrosion (on basis of weight loss). For convenience in comparing approximate costs of alloys the information received is given in Table VIII.

Current Work

For many years molybdenum has been considered a valuable alloying element to inhibit pitting attack of stainless steels. The American Iron and Steel Institute (AISI) appointed a committee of stainless steel producers to investigate further the role of molybdenum in providing resistance of stainless steel to pitting. In May 1975, the committee visited TVA at Muscle Shoals to discuss the results of corrosion tests conducted in the sulfur dioxide removal test programs at Colbert and Shawnee power plants. The committee invited TVA to participate in this study. Consequently, the following stainless steels containing the quantities of molybdenum indicated were included in the fourth series of corrosion tests now in progress:

Stainless steel	% Mo
Climax 18-2	2.1
Type 216	2.3
Type 316L	2.3
Type 316L	2.8
Type 317	3.2
AL 29-4	4.0
AL 6X	6.4

The corrosion study is being continued on materials of construction for the sulfur dioxide removal test facility at Shawnee Power Plant.

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The following firms supplied alloys (sheet and filler metal) for use in preparing welded corrosion test specimens:

Airco Vacuum Metals
Allegheny Ludlum Steel Corporation
Armco Steel Corporation
Carpenter Technology Corporation
Colt Industries
Huntington Alloys
Jessop Steel Company
Revere Copper and Brass, Incorporated
Stellite Division of Cabot Corporation
United States Steel Corporation

The cost of materials was kindly provided by Joe Martin of Huntington Alloys, Atlanta, Georgia, and David Pratt of Metal Goods, Incorporated, Memphis, Tennessee.

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Table I

Corrosion Tests Conducted in the Venturi System of the Limestone – Wet-Scrubbing Process for Sulfur Dioxide Removal from Stack Gas at Shawnee Power Plant

[Test period—3/25/74 to 4/24/75 (runs 600-1A through 624-1A); operating time—7315 hours or 304.8 days; and idle time—2381 hours or 99.2 days]

Corrosion specimens Exposed in	Inlet gas	Gas and spray	Gas and liquor	Gas and liquor	Gas and droplets	Exhaust gas (heated)	Exhaust gas (heated)	Exhaust gas (heated)	Effluent liquor	Liquor in clarifier
Locations (See Fig. 1), Ref. No.	1032	1011[a]	1006	1005	1004	1007	1014[b]	1015[b]	1008	1013
Gas										
Temperature, °F	275–330	80–170	80–160	80–150	80–140	255–260	255–260	255–260	–	–
Velocity, ft/sec	48–64	36–54	6–8	6–8	6–8	48–64	48–64	48–64	–	–
Flow rate, 1000's acfm at 330°F	25–30	19–25	19–25	19–25	19–25	25–30	25–30	25–30	–	–
Composition, % by volume										
SO_2	0.1–0.4	–	–	–	–	0.02–0.16	0.02–0.16	0.02–0.16	–	–
CO_2	10–18	–	–	–	–	11–19	11–19	11–19	–	–
O_2	5–15	–	–	–	–	6–16	6–16	6–16	–	–
H_2O	8–15	–	–	–	–	9–16	9–16	9–16	–	–
Fly ash, gr/std ft^3	2–7	–	–	–	–	0.01–0.04	0.01–0.04	0.01–0.04	–	–
Liquor										
Temperature, °F	–	–	–	–	–	–	–	–	90–150	70–100
Solids, undissolved, % by wt	–	–	–	–	–	–	–	–	7–16	0–95
Solids, dissolved, % by wt	–	–	–	–	–	–	–	–	0.5–2.1	0–[illegible]
pH	–	–	–	–	–	–	–	–	4.5–6.5	5.0–9.5
Ionic composition, ppm										
$SO_3^=$	–	–	–	–	–	–	–	–	35–1050	35–1050
$CO_3^=$	–	–	–	–	–	–	–	–	5–200	5–200
$SO_4^=$	–	–	–	–	–	–	–	–	300–1600	300–1600
Ca^{++}	–	–	–	–	–	–	–	–	100–4400	100–4400
Mg^{++}	–	–	–	–	–	–	–	–	50–6400	50–6400
Na^+	–	–	–	–	–	–	–	–	25–90	25–90
K^+	–	–	–	–	–	–	–	–	50–330	50–330
Cl^-	–	–	–	–	–	–	–	–	400–8400	400–8400
Corrosion rate of metals[c], mils/yr										
AL 6X, weld AL 6X	–	–	–	–	–	–	1	< 1	–	–
AL 29-4, weld AL 29-4	–	–	–	–	–	–	1	< 1	–	–
Brass, rod, weld Oxweld 25M	6[d]	–	5	5[d]	> 82	5	–	–	–	< 1
Carpenter 20Cb-3 weld Carpenter 20Cb-3	Pm	86	[e], Pm	[e]	[e], Pm	[e], F19	–	–	Neg.	Neg.
Cor-Ten A, weld E8018-C3	–	–	–	–	–	–	6	2	–	–
Cor-Ten B, weld E8018-C3	9[e], Pm	> 872	55	36[e]	62[f]	11	–	–	1	F6
Crucible 26-1, weld E-Brite 26-1	< 1	–	–	–	–	–	–	–	–	–
Cupro-Nickel 70-30, weld RCuNi	1	40	6	4	26[g]	1	–	–	< 1	< 1
E-Brite 26-1, weld E-Brite 26-1	–	9[e], F10	[e], F6	[e], F13	[e], F10	[e], F28	–	–	[e]	Neg.
Hastelloy B, weld Hastelloy B	1	74	18	12[e]	12[d]	–	–	–	Pm	[e]
Hastelloy C-276, weld Hastelloy C-276	< 1	8	< 1	< 1	Neg.	1	–	–	Neg.	Neg.
Haynes 25, weld Haynes No. 25	< 1	2	< 1	Neg.	Neg.	[e], F7	–	–	Neg.	Neg.
Incoloy 800, weld Inconel 82	–	174[e], F40	–	[e], F11	–	2	–	–	F15	Neg.
Incoloy 825, weld Incoloy 65	F5	9	< 1	[e]	[e]	1	–	–	Neg.	Neg.
Inconel 625, weld Inconel 625	< 1	8	< 1	< 1	Neg.	[e]	–	–	Neg.	Neg.
Jessop 700, weld Comete 82	–	–	–	–	–	–	1	< 1	–	–
Mild steel, A-285, weld E6012	–	–	–	–	–	–	5	2	–	–
Monel 400, weld Monel 60	1	64	9	9[d]	26	2	–	–	Neg.	–
Nitronic 50, weld Nitronic 50[h]	Pm	8, F5	< 1	–	[e]	–	–	–	Neg.	Neg.
Type 201, weld Type 316	–	52[e], F27	[e], F28	–	20	5	1	< 1	–	Neg.
Type 216, weld Type 216	–	–	–	–	–	–	1	< 1	–	–
Type 304L, weld Type 308	–	33[e], F14	–	[e], F13	25	[e], Pm	–	–	[e], F8	Neg.
Type 316L, weld Type 316L	Pm	21	< 1	< 1	[e], Pm	[e]	1	< 1	Neg.	Neg.
Type 317, weld Type 317	[e], Pm	16	[e]	–	[e]	–	–	–	–	–
Type 446, weld Type 309	–	> 68	–	–	–	–	–	–	–	–
USS 18-18-2, weld Inconel 82	< 1	26[e], F27	[e], F16	[e], F18	[e], F40	5, F6	–	–	[e], F8	[e], F13

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[a] After 4179 hours of operation, partial failure of a spool (specimen holder) occurred; a replacement spool of specimens was exposed during the remaining 3136 hours. The two spools did not contain identical specimens; the higher corrosion rate is given in cases of duplicate tests.

[b] Test period was from October 25, 1974, to April 24, 1975 (runs 611-1A to 624-1A), 3136 operating hours.

[c] Negligible (Neg.) indicates corrosion rates of less than 0.05 mil per year, and < 1 indicates corrosion rates from 0.05 to 0.49 mil per year; "F" preceding a number indicates pitting during the exposure period to the depth in mils shown by the number; and "Pm" indicates minute pits. Where localized attack is more severe than the rate determined by weight loss, no rate is given for general corrosion.

[d] Attack of weld.

[e] Crevice corrosion at Teflon insulator.

[f] Knife-line attack (groove adjacent to weld).

[g] Denickelification.

[h] Previously identified as Armco 22-13-5.

Table II

Corrosion Tests Conducted in the TCA System of the Limestone – Wet-Scrubbing Process for Sulfur Dioxide Removal from Stack Gas at Shawnee Power Plant

[Test period—10/24/73 to 4/17/74 (runs 525-2A through 530-2A); operating time—2954 hours or 123 days; and idle time—1246 hours or 52 days]

Test Phase A

Corrosion specimens Exposed in	Inlet gas	Gas and liquor	Gas and droplets	Gas and mist	Exhaust gas (heated)	Effluent liquor	Liquor in clarifier
Locations (See Fig. 2), Ref. No.	2002	2006	2005	2004	2007	2008	2013
Gas							
Temperature, °F	260–310	70–125	70–120	70–120	235–265	–	–
Velocity, ft/sec	33–50	8–10	8–10	8–10	33–50	–	–
Flow rate, 1000's acfm at 300°F	20–25	15–16	15–16	15–16	20–25	–	–
Composition, % by volume							
SO_2	0.1–0.4				0.04–0.1	–	–
CO_2	10–18				11–19	–	–
O_2	5–15				5–16	–	–
H_2O	8–15				9–16	–	–
Fly ash, gr/std ft^3	2–7				0.01–0.04	–	–
Liquor							
Temperature, °F	–	–	–	–	–	110–125	85–100
Solids, undissolved, % by wt	–	–	–	–	–	14–16	0–40
Solids, dissolved, % by wt	–	–	–	–	–	0.4–0.8	0.4–1.2
pH	–	–	–	–	–	5.1–5.8	5.5–9.5
Ionic composition, ppm							
$SO_3^=$	–	–	–	–	–	30–290	30–290
$CO_3^=$	–	–	–	–	–	40–380	40–380
$SO_4^=$	–	–	–	–	–	200–2700	200–2700
Ca^{++}	–	–	–	–	–	1100–2600	1100–2600
Mg^{++}	–	–	–	–	–	200–500	200–500
Na^+	–	–	–	–	–	30–120	30–120
K^+	–	–	–	–	–	50–520	50–520
Cl^-	–	–	–	–	–	1500–5000	1500–5000
Corrosion rate of metals[a], mils/yr							
Brass, red, weld Oxweld 25M	8^b	8^b	4	9^b	^{e}	< 1	1
Carpenter 7-Mo, weld 316	< 1, P5	$< 1^c$	^{c}, P8	< 1, Pm	Neg.	Neg.	Neg.
Carpenter 20Cb-3, weld Carpenter 20Cb-3	< 1, Pm	^{c}, Pm	^{c}, Pm	^{c}	P4	Neg.	Neg.
Cor-Ten B, weld E8018-C3	26	56^c	24	56	3	2	3
Crucible 26-1, weld E-Brite 26-1	< 1, P2	$< 1^c$	^{c}, P1	^{c}	Neg.	^{c}, Pm	Neg.
Cupro-Nickel 70-30, weld B259 RCuNi	–	9	4	10	1	< 1	< 1
Hastelloy B, weld Hastelloy B	–	31	8	10	1	^{b}	1
Hastelloy C-276, weld Hastelloy C-276	Neg.	< 1	Neg.	Neg.	Neg.	Neg.	Neg.
Incoloy 800, weld Inconel 82	–	–	–	^{c}	^{c}	^{c}, Pm	Neg.
Incoloy 825, weld Incoloy 65	Neg.	< 1	^{c}, P2	^{c}	Pm	Neg.	Neg.
Inconel 625, weld Inconel 625	Neg.	Neg.	Neg.	Neg.	Pm	Neg.	Neg.
Monel 400, weld Monel 60	–	15^b	5	11^b	1	< 1	< 1
Nitronic 50, weld Nitronic 50[d]	< 1, Pm	< 1, Pm	–	–	–	Neg.	–
Type 201, weld Type 316	^{e}, P2	^{c}, ^{c}P28	^{c}, P25	^{c}, P12	Pm	P8	Neg.
Type 316L, weld Type 316L	< 1, Pm	< 1, Pm	^{c}, Pm	^{c}	^{c}, P1	^{c}, Pm	Neg.
Type 317, weld Type 317	< 1	$< 1^c$	^{c}, P3	^{c}	Pm	Pm	Neg.
USS 18-18-2, weld Inconel 82	^{c}, Pm	–	–	^{c}, P10	< 1	^{c}, Pm	^{c}, P8

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[a] Negligible (Neg.) indicates corrosion rates of less than 0.05 mil per year and < 1 indicates corrosion rates from 0.05 to 0.49 mil per year; "P" preceding a number indicates pitting during the exposure period to the depth in mils shown by the number; and "Pm" indicates minute pits. Where localized attack is more severe than the rate determined by weight loss, no rate is given for general corrosion.

[b] Attack of weld.

[c] Crevice corrosion at Teflon insulator.

[d] Previously identified as Armco 22-13-5.

[e] Knife-line attack (groove adjacent to weld).

Table III

Corrosion Tests Conducted in the TCA System of the Limestone – Wet-Scrubbing Process for Sulfur Dioxide Removal from Stack Gas at Shawnee Power Plant

[Test period—5/10/74 to 4/21/75 (runs 531-2A through 545-2A); operating time—6456 hours or 269 days; and idle time—1848 hours or 77 days]

Test Phase B

Corrosion specimens Exposed in	Inlet gas	Gas and liquor	Gas and droplets	Gas and mist	Exhaust gas (heated)	Exhaust gas (heated)	Exhaust gas (heated)	Effluent liquor	Liquor in clarifier
Locations (See Fig. 2), Ref. No.	2002	2006	2005	2004	2007	2014[a]	2015[a]	2008	2013
Gas									
Temperature, °F	260–310	70–130	70–125	70–125	235–265	235–265	230–260	–	–
Velocity, ft/sec	35–56	8–11	7–9	6–8	35–56	35–56	35–56	–	–
Flow rate, 1000's acfm at 300°F	20–32	15–24	15–24	15–24	20–32	20–32	20–32	–	–
Composition, % by volume									
SO_2	0.1–0.4				0.04–0.1	0.04–0.1	0.04–0.1	–	–
CO_2	10–18	–	–	–	11–19	11–19	11–19	–	–
O_2	5–15	–	–	–	6–16	6–16	6–16	–	–
H_2O	8–15	–	–	–	9–16	9–16	9–16	–	–
Fly ash, gr/std ft^3	2–7	–	–	–	0.01–0.04	0.01–0.04	0.01–0.04	–	–
Liquor									
Temperature, °F	–	–	–	–	–	–	–	110–130	85–100
Solids, undissolved, % by wt	–	–	–	–	–	–	–	7–18	0–40
Solids, dissolved, % by wt	–	–	–	–	–	–	–	0.3–6.0	0.3–6.0
pH	–	–	–	–	–	–	–	4.7–5.9	5.5–9.5
Ionic composition, ppm									
$SO_3^{=}$	–	–	–	–	–	–	–	70–5,000	70–5,000
$CO_3^{=}$	–	–	–	–	–	–	–	30–1,000	30–1,000
$SO_4^{=}$	–	–	–	–	–	–	–	300–39,000	300–44,000
Ca^{++}	–	–	–	–	–	–	–	100–2,600	100–2,600
Mg^{++}	–	–	–	–	–	–	–	260–12,000	260–12,000
Na^{+}	–	–	–	–	–	–	–	35–60	35–60
K^{+}	–	–	–	–	–	–	–	40–115	40–115
Cl^{-}	–	–	–	–	–	–	–	800–4,500	800–4,500
Corrosion rate of metals[b], mils/yr									
AL 6X, weld AL 6X	–	–	–	–	–	Neg.	Neg.	–	–
AL 29-4, weld AL 29-4	–	–	–	–	–	Neg.	Neg.	–	–
Brass, red, weld Oxweld 25M	9[c]	[c, d]	2	9[c]	1	–	–	< 1	1
Carpenter 7-Mo, weld 316	–	[d]	–	–	–	–	–	Neg.	–
Carpenter 20Cb-3, weld Carpenter 20Cb-3	< 1	[d]	Neg.	Neg.	Neg.	–	–	Neg.	Neg.
Cor-Ten A, weld E8018-C3	–	–	–	–	–	1	< 1	–	–
Cor-Ten B, weld E8018-C3	3[c]	> 57	11[e]	51	1	–	–	1	1, P5
Cupro-Nickel 70-30, weld M-59 RCuNi	1	[d, e]	[e]	9	[e]	–	–	< 1	1
E-Brite 26-1, weld E-Brite 26-1	–	[d, e], P4	P26	[e]	[e]	–	–	Neg.	Neg.
Hastelloy B, weld Hastelloy B	< 1	[d]	2	1[e]	< 1	–	–	Neg.	[e]
Hastelloy C-276, weld Hastelloy C-276	< 1	[d]	Neg.	Neg.	Neg.	–	–	Neg.	Neg.
Haynes 6B, weld Haynes No.25	< 1	[d]	Neg.	Neg.	Neg.	–	–	Neg.	Neg.
Incoloy 800, weld Inconel 82	–	[d, e], P15	[e], P10	[e], P11	P5	–	–	–	Neg.
Incoloy 825, weld Incoloy 65	< 1	[d]	Neg.	[e]	–	–	–	Neg.	Neg.
Inconel 625, weld Inconel 625	< 1	[d]	Neg.	Neg.	Neg.	–	–	Neg.	Neg.
Jessop 700, weld Comete 3[illegible]	–	–	–	–	–	Neg.	Neg.	–	–
Mild steel A-285, weld E601[illegible]	–	–	–	–	–	1	< 1	–	–
Monel 400, weld Monel 60	< 1	[d, e]	3	1[c]	< 1	–	–	< 1	1
Nitronic 50, weld Nitronic 50[f]	< 1	[d, e]	Neg.	–	–	–	–	Neg.	Neg.
Type 201, weld Type 316	< 1	[d, e], P11	[e], P15	[e], P8	Neg.	Neg.	[e]	Neg.	P9
Type 216, weld Type 216	–	–	–	–	–	Neg.	[e]	–	–
Type 304L, weld Type 308L	–	–	[e], P22	[e], P12	[e], P7	–	–	–	–
Type 316L, weld Type 316L	< 1	[d]	Neg.	[e]	Neg.	Neg.	[e]	Neg.	Neg.
Type 317, weld Type 317	< 1	[d, e]	[e]	[e]	Neg.	–	–	Neg.	Neg.
USS 18-18-2, weld Inconel 82	–	[d, e], P17	–	[e], P12	< 1	–	–	[e]	[e], P25

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[a] Test period was from October 16, 1974, to April 21, 1975 (runs 535-2A to 545-2A), 389[illegible] hours operating time.

[b] Negligible (Neg.) indicates corrosion rates of less than 0.05 mil, and < 1 indicates corrosion rates from 0.05 to 0.49 mil per year; "P" preceding a number indicates pitting during the exposure period to the depth in mils shown by the number; and "Pm" indicates minute pits. Where localized attack is more severe than the rate determined by weight loss, no rate is given for general corrosion.

[c] Attack of weld.

[d] Specimen worn by movement of plastic balls; corrosion on the basis of weight loss could not be determined.

[e] Crevice corrosion at Teflon insulator.

[f] Previously identified as Armco 22-13-5.

Table IV

Composition of Alloys Tested in the Limestone - Wet-Scrubbing Systems for Sulfur Dioxide Removal from Stack Gas at Shawnee Power Plant

Alloys	Chemical analysis, %												
	C	Cr	Ni	Fe	Cu	Mo	Mn	Si	P	S	Al	Ti	Others
AL 6X^a	0.027	20.32	24.17	Bal.	-	6.42	1.45	0.56	0.025	0.004	-	-	N, 0.05
AL 29-4^a	0.004	29.5	0.12	Bal.	-	3.95	0.10	0.05	0.013	0.013	-	-	N, 0.010
Brass, Red	-	-	-	0.05^b	34-36	-	-	-	-	-	-	-	Zn, Bal.; Pb, 0.05^b
Carpenter 7-Mo^a	0.05	27.07	4.25	Bal.	0.14	1.44	0.50	0.38	0.022	0.013	-	-	-
Carpenter 20Cb-3	0.07^b	19-21	32-38	Bal.	3-4	2-3	2.00^b	1.00^b	0.035^b	0.035^b	-	-	Cb+Ta, 8xC
Cor-Ten A^a	0.11	0.66	0.33	Bal.	0.36	-	0.39	0.44	0.096	0.026	-	-	-
Cor-Ten B^a	0.066	0.52	0.013	Bal.	0.31	0.010	1.20	0.29	0.012	0.031	0.056	-	V, 0.05
Crucible 26-1^a	0.02	25.60	0.25	Bal.	0.04	0.99	0.27	0.43	0.030	0.008	-	0.42	N, 0.026
Cupro-Nickel 70-30^a	-	-	31.00	0.53	67.79	-	0.52	-	0.003	0.005	-	-	Zn, 0.034; Pb, 0.002
E-Brite 26-1^a	< 0.001	26.17	0.06	Bal.	0.01	1.00	0.01	0.19	0.010	0.012	-	-	N, 0.010
Hastelloy B^a	< 0.01	0.19	Bal.	5.75	-	26.20	0.58	0.01	0.005	0.006	-	-	Co, 0.35; V, 0.26
Hastelloy C-276^a	0.002	15.37	Bal.	5.96	-	16.32	0.49	< 0.01	0.012	0.010	-	-	Co, 1.54; W, 3.51; V, 0.25
Haynes 6B^a	0.96	29.75	2.13	2.36	-	1.08	1.40	0.36	-	-	-	-	Co, Bal.; W, 4.30
Incoloy 800^a	0.04	21.11	31.32	45.01	0.40	-	0.34	0.31	-	0.007	0.48	0.46	-
Incoloy 825^a	0.04	22.25	42.22	28.30	2.12	-	0.56	0.34	-	0.007	0.06	0.66	-
Inconel 600	0.15^b	14-17	72	6-10	0.50^b	-	1.00^b	0.50^b	-	0.005^b	-	-	-
Inconel 601	0.10^b	21-25	58-63	Bal.	1.0^b	-	1.0^b	0.50^b	-	0.015^b	1.0-1.7	-	-
Inconel 625	0.1^b	20-23	Bal.	5.00^b	-	8-10	0.5^b	0.5^b	0.015^b	0.015^b	0.4^b	0.4^b	Co, 1.0^b; Cb+Ta, 3.15-4.15
Inconel 702	0.10^b	14-17	Bal.	2.0^b	0.5^b	-	1.0^b	0.7^b	-	0.01^b	2.75-3.75	0.25-1.00	-
Jessop 700	0.03	21.00	25.00	Bal.	-	4.5	1.70	0.50	-	-	-	-	Cb, 0.30
Mild Steel A-285	0.35^b	-	-	Bal.	0.35^b	-	0.90^b	-	0.05^b	0.05^b	-	-	-
Monel 400^a	0.09	-	64.66	1.00	33.06	-	1.08	0.08	-	0.008	0.004	-	-
Nitronic 50	0.06^b	20.5-23.5	11.5-13.5	Bal.	-	1.5-3.0	4.0-6.0	1.0^b	0.04^b	0.03^b	-	-	N, 0.2-0.4; Cb, 0.1-0.3; V, 0.1-0.3
Type 201	0.15^b	16-18	3.5-5.5	Bal.	-	-	5.5-7.5	1.00^b	0.06^b	0.03^b	-	-	N, 0.25^b
Type 216^a	0.069	19.54	6.77	Bal.	-	2.31	8.21	0.23	0.023	0.005	-	-	N, 0.353
Type 304L	0.030^b	18-20	8-12	Bal.	-	-	2.00^b	1.00^b	0.045^b	0.030^b	-	-	-
Type 316L	0.030^b	16-18	10-14	Bal.	-	2.0-3.0	2.00^b	1.00^b	0.045^b	0.030^b	-	-	-
Type 317^a	0.06	18.6	12.6	Bal.	0.14	3.0	1.3	1.90	0.013	0.010	-	-	-
Type 446^a	0.10	24.6	0.50	Bal.	0.045	0.10	0.71	0.37	0.013	0.010	0.003	< 0.02	N, 0.15; V, < 0.05
USS 18-18-2^a	0.065	18.2	13.0	Bal.	0.03	0.018	1.50	1.94	0.007	0.009	0.001	-	N, 0.04

[a] Analysis was supplied with the material received for use in corrosion tests.
[b] Maximum.

TABLE V

Analyses[a] of Deposits in Limestone - Wet-Scrubbing Systems for Sulfur Dioxide Removal from Stack Gas at Shawnee Power Plant

Identification of sample			Composition, % by weight					
Date	Number	Location	$CaSO_3$	$CaSO_4$	$CaCO_3$	$CaCl_2$	MgO	Acid insoluble
Venturi System								
10/15/74	VD-4	Multilayered scale from second door of afterscrubber	10.58	79.12	2.23	Trace	0.09	7.97
10/15/74	VD-3	Solids from duct at reheater outlet	0.82	65.58	Trace	Trace	0.35	33.25
10/15/74	VD-2[b]	Mud with green under layer from ID fan casing	0.97	84.24	0.12	Trace	0.61	14.09
10/15/74	VD-1[c]	Solids from rear faces of the ID fan blades	0.17	71.66	Trace	Trace	9.40	18.77
10/18/74	VD-2	Scale from D-101 walls	9.79	74.15	12.04	Trace	0.97	3.04
10/27/74	VD-1	Scale from bottom of (inlet) mist eliminator vanes	21.35	67.23	3.33	Trace	0.33	7.76
11/5/74	VD-1	Scale from underside of top mist eliminator vanes	0.49	60.04	0.53	1.44	0.45	37.04
11/18/74	VD-2	Scale from top of mist eliminator	Trace	57.41	0.44	Trace	0.30	41.85
11/18/74	VD-3	Multilayered scale from flooded elbow	0.27	66.14	Trace	Trace	0.27	33.32
1/3/75	VD-2	Scale from underspray headers	8.71	68.30	2.96	0.52	0.13	19.38
TCA System, Test Phase A								
11/15/73	TCAD-2	Solids from various locations on wash tray inlet	24.54	34.87	3.62	1.92	0.10	35.04
11/15/73	TCAD-1	Crystalline solids from inlet tips of mist eliminator vanes	0.88	67.42	1.89	4.53	0.30	25.57
11/20/73	TCAD-1	Composite scale from top of specimens on floor D-201	26.17	61.00	4.37	0.14	0.06	8.26
1/24/74	TCAD-1	Solids from inlet vanes of mist eliminator	2.29	66.08	1.48	2.21	0.05	27.90
1/25/74	TCAD-1	Solids 13 inches upstream, inlet duct spray nozzle	4.32	8.11	4.73	Trace	0.18	82.66
1/25/74	TCAD-2	Solids from wash tray inlet	30.09	34.04	14.45	Trace	0.26	21.16
1/28/74	TCAD-1	Scale from G-201 discharge pipe	13.05	69.40	7.73	1.15	0.13	8.56
TCA System, Test Phase B								
6/20/74	TCAD-1	Scale from underside of wash tray	10.52	69.40	0.15	Trace	0.38	19.54
6/26/74	TCAD-1	Scale from bottom sphere bed grid	0.84	94.81	Trace	3.13	0.22	1.00
6/26/74	TCAD-2	Scale from top of wash tray bubble caps	0.65	68.78	1.14	1.15	0.30	29.00
6/26/74	TCAD-2	Scale from wash tray overflow weir	0.67	39.95	0.62	0.10	0.40	58.26
6/27/74	TCAD-1	Scale from south wall under bottom grid	5.80	55.46	5.50	1.05	0.79	31.42
5/29/74	TCAD-5	Solids from corroded area in expansion joint above ID fan	1.21	33.05	0.91	0.85	0.19	63.81
7/29/74	TCAD-2	Scale from wall above top grid	1.64	90.15	0.88	2.66	0.32	4.36
7/29/74	TCAD-4	Dry, tan-colored solids from ID fan casing	1.79	22.89	0.90	3.53	0.42	73.54
8/23/74	TCAD-2	Solids in inlet duct 2 inches upstream from cooling sprays	23.01	37.54	0.26	1.76	5.80	31.64
8/30/74	TCAD-1	Solids from inlet damper to ID fan	6.45	30.65	3.35	Trace	2.4	57.15

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[a] Information taken from reports by J. B. Barkley to J. K. Metcalfe during the period 11/15/73 to 1/3/75.

[b] There was 16.72% by weight free acidic material as sulfuric acid before the sample was normalized to 100% dry solids.

[c] There was 26.31% by weight free acidic material as sulfuric acid before the sample was normalized to 100% dry solids.

TABLE VI

Hardness of Neoprene Linings of Equipment in the Limestone – Wet-Scrubbing Systems for Sulfur Dioxide Removal from Stack Gas at Shawnee Power Plant

(Exposure period: 8/12/72 to 4/28/75)

Location of hardness test	Durometer "A" hardness		
	Original[a]	Current[b]	At °F[c]
Venturi System (Operating hours: accumulated—13,669; since last inspection—9468)[d]			
Crossover Duct from Flooded Elbow to After Scrubber, Patched Area:			
New material, patch	–	66–70	73
Old material, near patch	60-65	54–60	73
After-Scrubber Tower:			
Eight inches below Type 316L stainless steel at venturi section	60-65	53–58	73
Sidewalls near cone-shaped bottom (approx. elevation, 371 ft)	60-65	50–60	73
At approximate elevation, 387 feet	60-65	51–55	72
At approximate elevation, 392 feet	60-65	51–59	72
Three inches below mist eliminator (approx. elevation, 398 ft)	60-65	47–57	73
Three inches above mist eliminator (approx. elevation, 401 ft)	60-65	42–47	73
Six inches below the stainless steel duct (approx. elevation, 406 ft)	60-65	45–48	73
Clarified Process Water Storage Tank, D-103:			
Above liquid level	55–60	63–65	82
Below liquid level	55–60	65–71	82
Agitator blades	–	58–60	82
Reslurry Tank, D-401:			
Above liquid level	55–60	60–66	82
Blades of Agitator In:			
Effluent hold tank, D-101	60–70	57–62	82
TCA System (Operating hours: accumulated—14,237; since last inspection—9410)[d]			
Scrubber Tower:			
Four inches above inlet gas duct (approx. elevation, 376 ft)	60-65	46–52	65
Six inches above bottom grid (approx. elevation, 380 ft)	60-65	51–55	65
Three feet above the second grid, near Test 2006 (approx. elevation, 386 ft)	60-65	52–56	65
Four feet below Koch tray (approx. elevation, 398 feet)	60-65	48–54	74
Two feet above the Koch tray (approx. elevation, 404 ft)	60-65	44–46	74
Clarified Process Water Storage Tank, D-203:			
Above liquid level	55–60	61–66	82
Below liquid level	55–60	72–75	82
Agitator blades	–	64–67	82
Blades of Agitator In:			
Effluent hold tank, D-201	60–70	57–62	70
Neoprene Lining from Centrifugal Pump, G-201[e]:			
Suction side of casing	54–56	62–66	74
Seal side of casing	54–56	65–69	74
Impeller	54–56	66–68	74

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[a] Values not determined by TVA but were taken from information supplied to contractors for bidding on construction. The ASTM standard D2240-68 specifies that tests for hardness of rubber be made at 73°F.

[b] The instrument used to determine the durometer hardness of neoprene linings during inspection of the plants (May 29–31, 1975) was Shore "A2," ASTM D2240. Note that the measurements were made over a wide range of temperatures; therefore, an exact comparison of hardness values is not possible. Usually three or more tests were made in an area.

[c] The atmospheric temperature varied from about 65° to 82°F while tests for hardness were being made.

[d] The previous inspection was September 18–20, 1973.

[e] The impeller and liners were removed because of impact and abrasion damage. The service life of the impeller and liners is not available.

Table VII

Compilation of Corrosion Data of Metals in the Two Limestone – Wet-Scrubbing Systems for Sulfur Dioxide Removal from Stack Gas at Shawnee Power Plant

(Test period—10/24/73 to 4/24/75)

		Corrosion[a]						
			Specimens pitted[b]				Specimens with other types of attack	
				Depth, mils				
Alloy	No. of specimens tested	On basis of wt. loss,[c] mils/yr	No.	Min.	Max.	Specimens with crevice attack, No.	No.	Identification
AL 6X	4	Neg. – 1	0	0	0	0	0	0
AL 29-4	4	Neg. – 1	0	0	0	0	0	0
Brass, Red	20	< 1 – > 82	0	0	0	0	8	8[d]
Carpenter 7-Mo	8	Neg. – < 1	3	M	8	2	0	0
Carpenter 20Cb-3	22	Neg. – 86	8	M	19	7	0	0
Cor-Ten A	4	< 1 – 6	0	0	0	0	0	0
Cor-Ten B	22	1 – > 872	3	M	6	5	1	1[e]
Crucible 26-1	8	Neg. – < 1	3	M	2	4	0	0
Cupro-Nickel 70-30	21	< 1 – 49	0	0	0	3	1	1[f]
E-Brite 26-1	13	Neg. – 9	7	4	28	9	0	0
Hastelloy B	20	Neg. – 74	1	0	M	4	2	2[d]
Hastelloy C-276	22	Neg. – 8	0	0	0	0	0	0
Haynes 6B	15	Neg. – 2	1	0	7	1	0	0
Incoloy 800	14	Neg. – 174	8	M	40	8	0	0
Incoloy 825	21	Neg. – 9	3	M	5	5	0	0
Inconel 625	22	Neg. – 8	1	0	M	1	0	0
Jessop 700	4	Neg. – 1	0	0	0	0	0	0
Mild Steel A-285	4	< 1 – 5	0	0	0	0	0	0
Monel 400	20	Neg. – 64	0	0	0	1	4	4[d]
Nitronic 50	14	Neg. – 8	4	M	5	2	0	0
Type 201	23	Neg. – 32	12	M	28	9	1	1[e]
Type 216	4	Neg. – 1	0	0	0	1	0	0
Type 304L	9	Neg. – 33	7	M	22	7	0	0
Type 316L	26	Neg. – 21	7	M	1	9	0	0
Type 317	18	Neg. – 16	4	M	3	9	0	0
Type 446	1	> 68	0	0	0	0	0	0
USS 18-18-2	18	< 1 – 26	14	M	40	14	0	0

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[a] Tables I, II, and III give corrosion data for the materials tested in the venturi and TCA scrubber systems. Because the number of specimens tested of each alloy ranged from 1 to 26, an order of decreasing corrosion resistance could not be established.

[b] M, minute pit; the numerical values show the actual depth of penetration in mils during test period.

[c] The range of corrosion rates does not include severe abrasion caused by spheres rubbing the specimen in test 2006.

[d] Attack of weld.

[e] Knife-line attack (groove adjacent to weld).

[f] Denickelification.

Table VIII

Cost of Alloys Tested in the Experimental Facilities for the Removal of Sulfur Dioxide from Stack Gases at the Shawnee Power Plant

(Test period inclusive: 10/24/73 to 4/24/75)

	Cost[a] for commercial quantities					
	3/4-inch tubing, 0.065-inch wall			Sheet, 0.120-inch		
	$/ft		Ratio based on Type 304	$/lb		Ratio based on Type 304
Source of information[b]:	A	B		A	B	
Alloys tested						
AL 6X				2.65		3.4
AL 29-4				2.65		3.4
Brass, red	0.74		0.6			
Carpenter 7-Mo						
Carpenter 20Cb-3						
Cor-Ten A				0.20		0.3
Cor-Ten B						
Crucible 26-1				1.23		1.6
Cupro-Nickel 70-30	1.01		0.9			
E-Brite 26-1						
Hastelloy B	6.86		5.9	7.16		9.1
Hastelloy C-276	6.72		5.7	7.16		9.1
Haynes 6B				13.42		17.0
Incoloy 800		1.85	1.6		2.38	3.0
Incoloy 825		2.79	2.4		3.14	4.0
Inconel 601		2.29	2.0		3.13	4.0
Inconel 625		4.81	4.11		4.81	6.1
Inconel 702					4.91	6.2
Jessop 700						
Mild Steel, A-285				0.17		0.2
Monel 400		2.08	1.8		3.09	3.9
Nitronic 50				1.69		2.1
Type 201				0.76		1.0
Type 216						
Type 304[c]		1.17	1.0	0.79		1.0
Type 304L		1.18	1.0	0.86		1.1
Type 316L		1.47	1.26	1.26		1.6
Type 317		1.90	1.62	1.80		2.3
Type 446						
USS 18-18-2						

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[a] Details concerning the preparation and condition of each alloy tested are too numerous to list. Definite information can be obtained from manufacturer or supplier.

[b] A, Metal Goods, Incorporated, Memphis, Tennessee, January 1976.
B, Huntington Alloy Products Division, The International Nickel Company, Incorporated, Atlanta, Georgia, December 1975.

[c] Type 304 was not tested but is used as the basis ($1.17/ft for 3/4-in tubing and $0.79/lb for 0.120-in sheet) for approximate cost ratios.

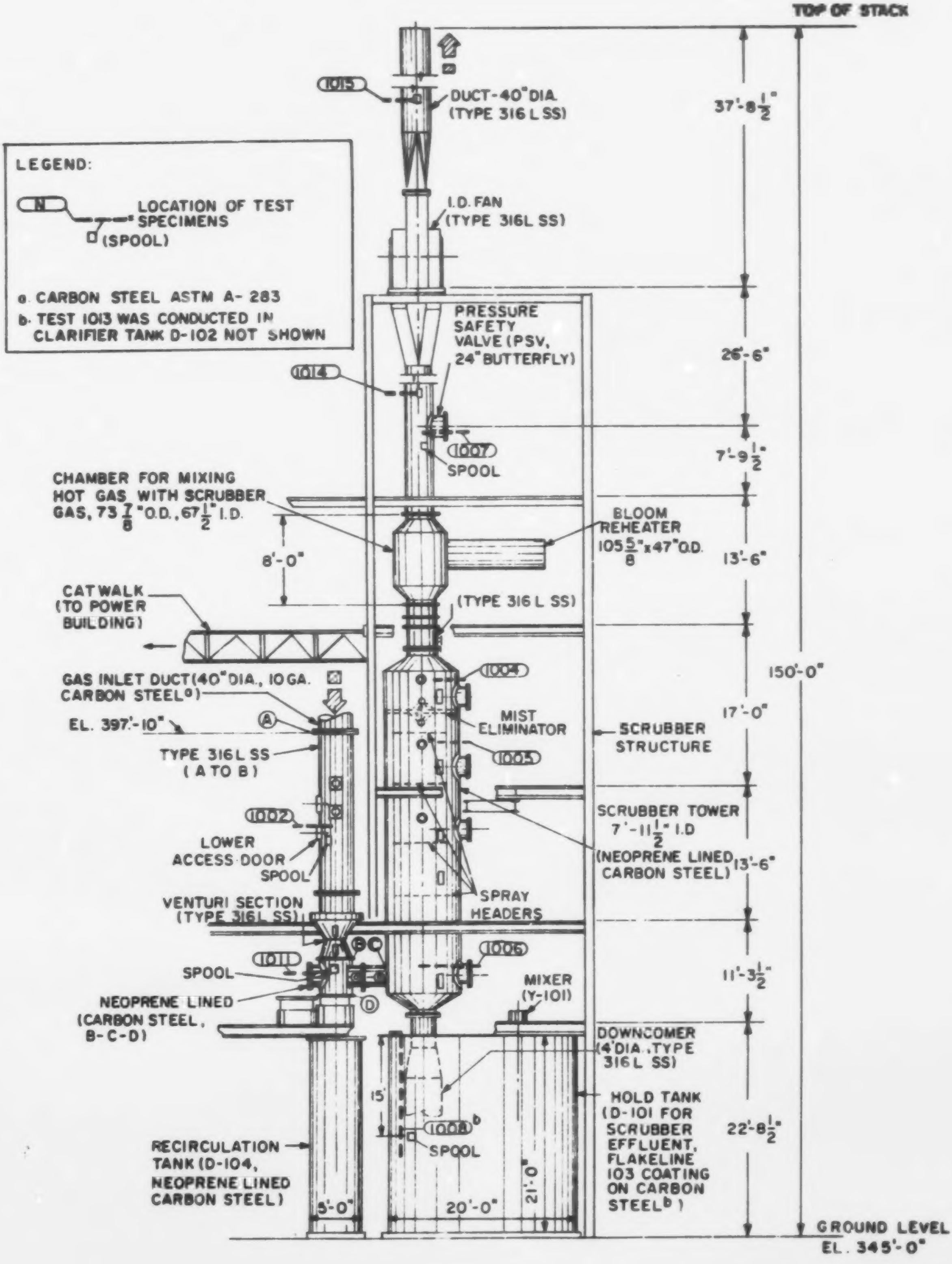

TOP OF STACK
1015
DUCT-40" DIA.
(TYPE 316 L SS)
37'-8$\frac{1}{2}$"
LEGEND:
N
LOCATION OF TEST SPECIMENS
(SPOOL)
a. CARBON STEEL ASTM A-283
b. TEST 1013 WAS CONDUCTED IN CLARIFIER TANK D-102 NOT SHOWN
I.D. FAN
(TYPE 316L SS)
PRESSURE SAFETY VALVE (PSV, 24" BUTTERFLY)
26'-6"
1014
1007
SPOOL
7'-9$\frac{1}{2}$"
CHAMBER FOR MIXING HOT GAS WITH SCRUBBER GAS, 73$\frac{7}{8}$" O.D., 67$\frac{1}{2}$" I.D.
BLOOM REHEATER 105$\frac{5}{8}$" x 47" O.D.
8'-0"
13'-6"
(TYPE 316 L SS)
CATWALK (TO POWER BUILDING)
1004
150'-0"
GAS INLET DUCT (40" DIA., 10 GA. CARBON STEEL^a)
A
EL. 397'-10"
MIST ELIMINATOR
SCRUBBER STRUCTURE
17'-0"
TYPE 316L SS (A TO B)
1005
1002
SCRUBBER TOWER 7'-11$\frac{1}{2}$" I.D
(NEOPRENE LINED CARBON STEEL)
13'-6"
LOWER ACCESS DOOR
SPOOL
VENTURI SECTION (TYPE 316L SS)
SPRAY HEADERS
B C
1011
1006
SPOOL
11'-3$\frac{1}{2}$"
MIXER (Y-101)
NEOPRENE LINED (CARBON STEEL, B-C-D)
D
DOWNCOMER (4' DIA. TYPE 316L SS)
15'
HOLD TANK (D-101 FOR SCRUBBER EFFLUENT, FLAKELINE 103 COATING ON CARBON STEEL^b)
1008^b
SPOOL
22'-8$\frac{1}{2}$"
RECIRCULATION TANK (D-104, NEOPRENE LINED CARBON STEEL)
21'-0"
5'-0"
20'-0"
GROUND LEVEL
EL. 345'-0"

FIGURE 1
VENTURI SCRUBBER SYSTEM (C-101)

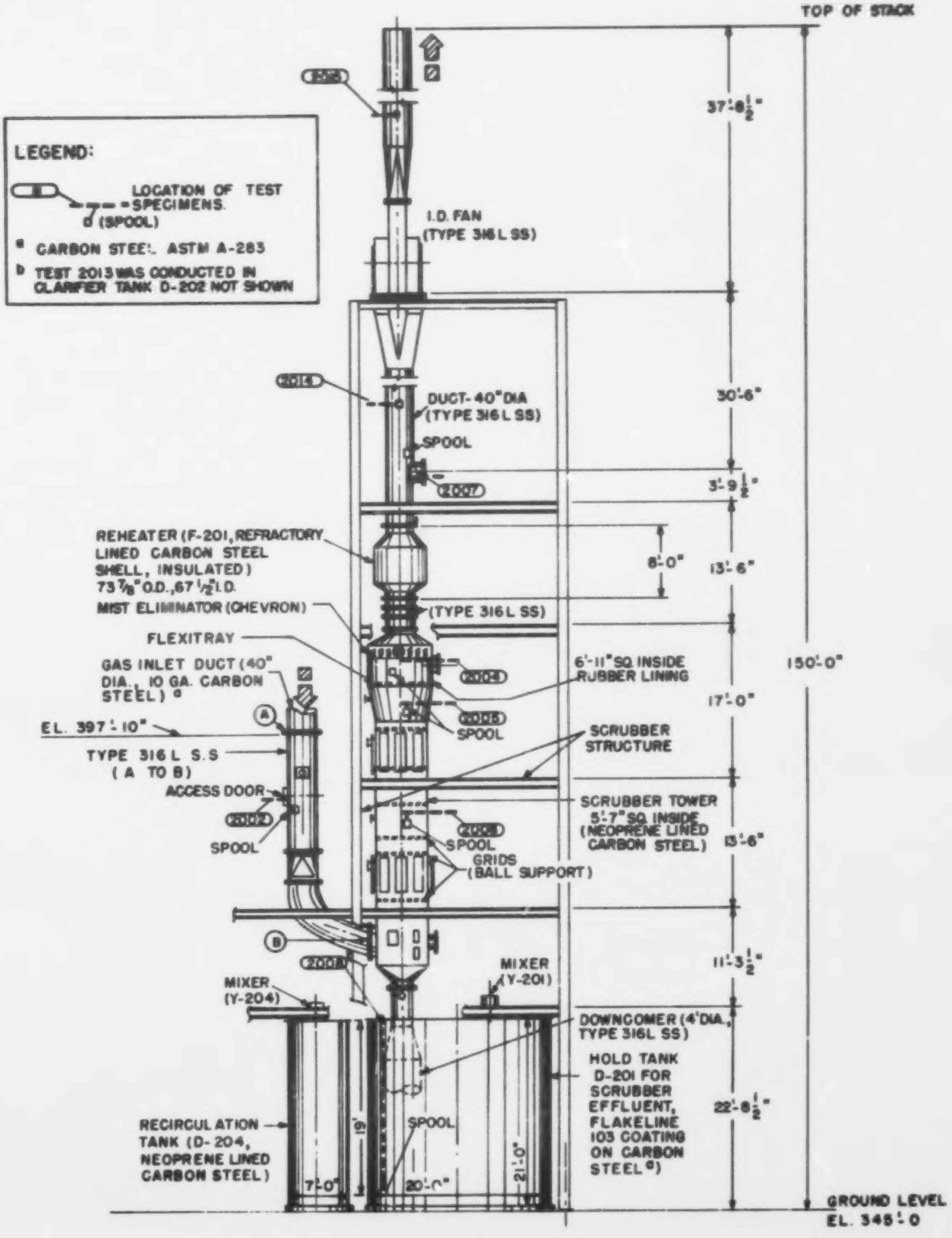

LEGEND:
LOCATION OF TEST SPECIMENS.
(SPOOL)
a CARBON STEEL. ASTM A-283
b TEST 2013 WAS CONDUCTED IN CLARIFIER TANK D-202 NOT SHOWN
TOP OF STACK
37'-8 1/2"
I.D. FAN (TYPE 316 L SS)
2014
DUCT-40" DIA (TYPE 316 L SS)
SPOOL
2007
30'-6"
3'-9 1/2"
REHEATER (F-201, REFRACTORY LINED CARBON STEEL SHELL, INSULATED) 73 7/8" O.D., 67 1/2" I.D.
8'-0"
13'-6"
MIST ELIMINATOR (CHEVRON)
(TYPE 316L SS)
FLEXITRAY
2004
6'-11" SQ. INSIDE RUBBER LINING
2005
SPOOL
GAS INLET DUCT (40" DIA., 10 GA. CARBON STEEL) a
A
EL. 397'-10"
TYPE 316 L S.S (A TO B)
ACCESS DOOR
2002
SPOOL
SCRUBBER STRUCTURE
17'-0"
150'-0"
SCRUBBER TOWER 5'-7" SQ. INSIDE (NEOPRENE LINED CARBON STEEL)
SPOOL
GRIDS (BALL SUPPORT)
13'-6"
B
MIXER (Y-201)
11'-3 1/2"
MIXER (Y-204)
DOWNCOMER (4' DIA., TYPE 316L SS)
HOLD TANK D-201 FOR SCRUBBER EFFLUENT, FLAKELINE 103 COATING ON CARBON STEEL a)
RECIRCULATION TANK (D-204, NEOPRENE LINED CARBON STEEL)
SPOOL
16'
21'-0"
22'-8 1/2"
7'-0"
20'-0"
GROUND LEVEL EL. 348'-0

FIGURE 2
TURBULENT CONTACT SCRUBBER SYSTEM, TCA-(C-201)
(MOBILE BED)

FIGURE 3

SPOOL ASSEMBLY OF CORROSION TEST SPECIMENS (2-INCH DISK)

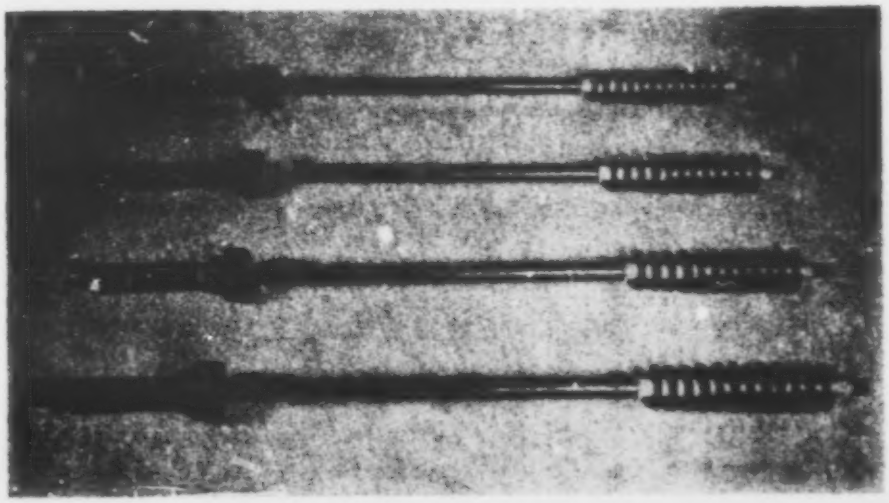


FIGURE 4

PROBE ASSEMBLY OF CORROSION TEST SPECIMENS (2-INCH DISK)

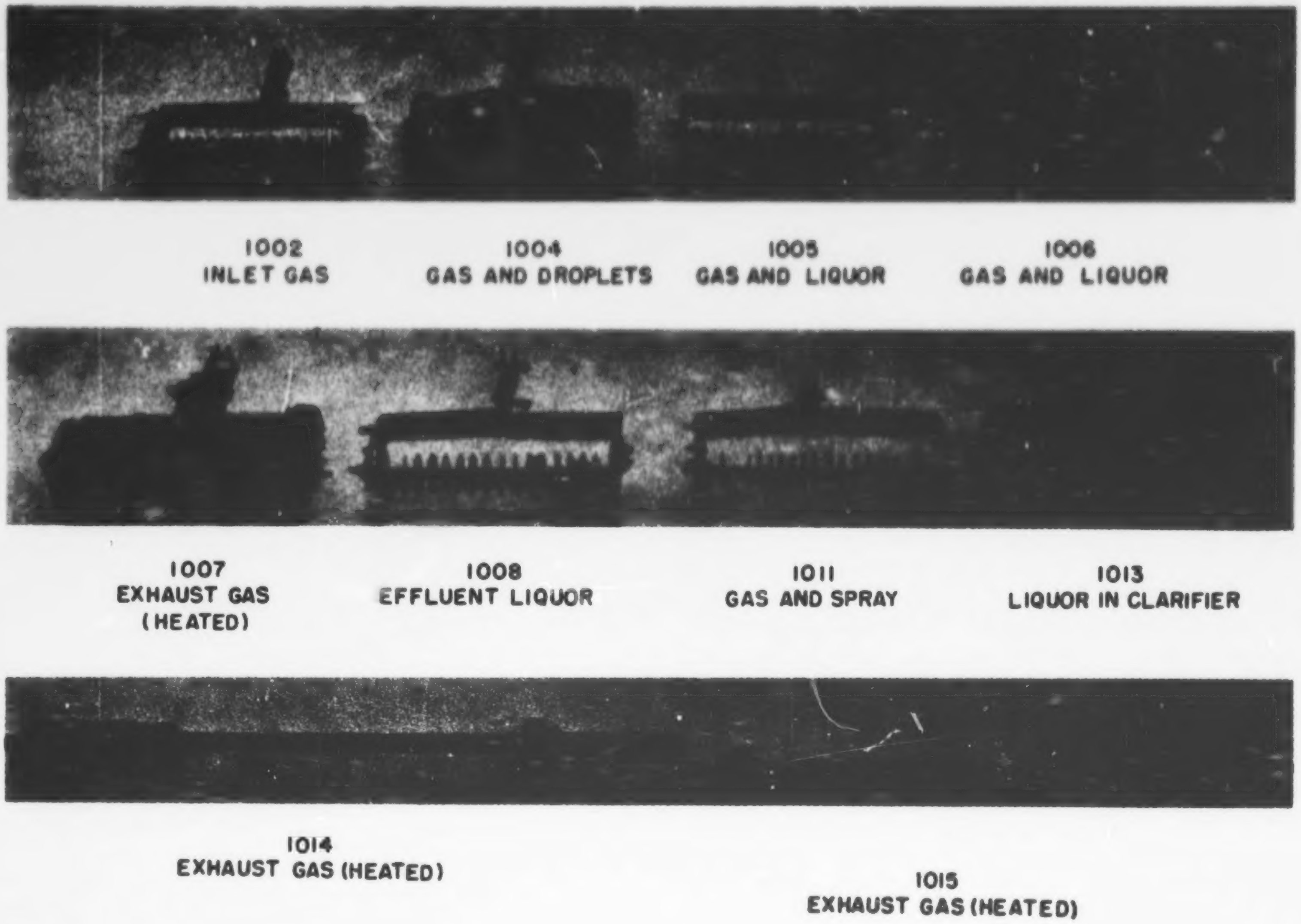
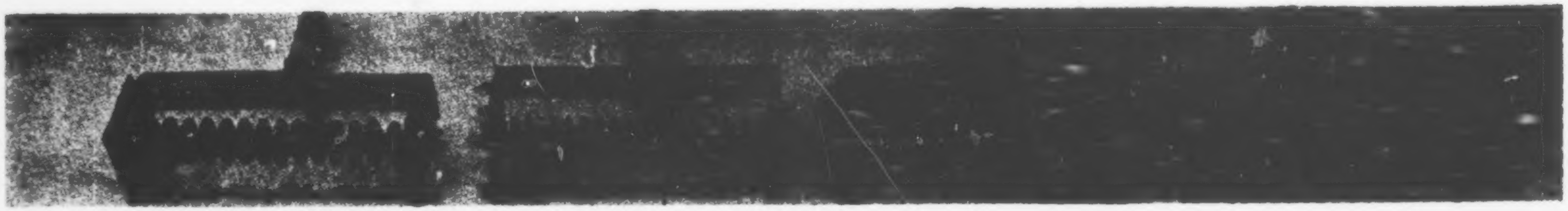

1002
INLET GAS
1004
GAS AND DROPLETS
1005
GAS AND LIQUOR
1006
GAS AND LIQUOR
1007
EXHAUST GAS
(HEATED)
1008
EFFLUENT LIQUOR
1011
GAS AND SPRAY
1013
LIQUOR IN CLARIFIER
1014
EXHAUST GAS (HEATED)
1015
EXHAUST GAS (HEATED)

FIGURE 5

DISK SPECIMENS AFTER EXPOSURE IN VENTURI SYSTEM
(MARCH 15, 1974—APRIL 24, 1975)

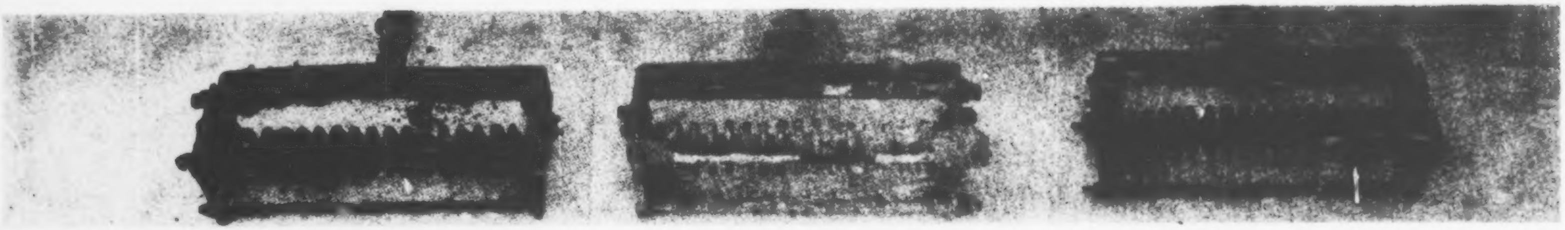


2002
INLET GAS

2004
GAS AND MIST

2005
GAS AND DROPLETS

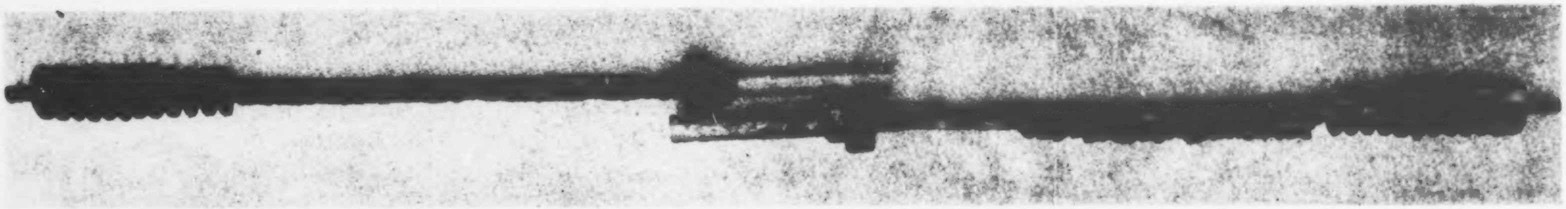
2006
GAS AND LIQUOR



2007
EXHAUST GAS
(HEATED)

2008
EFFLUENT LIQUOR

2013
LIQUOR IN CLARIFIER



2014
EXHAUST GAS(HEATED)

2015
EXHAUST GAS(HEATED)

FIGURE 6

DISK SPECIMENS AFTER EXPOSURE IN TCA SYSTEM
(TEST PHASE B, MAY 10, 1974—APRIL 21, 1975)

FIGURE 7
BULL NOZZLE ABOVE VENTURI SECTION, ERODED INSIDE
BY SLURRY AND OUTSIDE BY FLY ASH—185 MILS PER YEAR

FIGURE 8
SPRAY HEADER IN VENTURI AFTERSCRUBBER, TYPE 316 TEE
AND TYPE 304 REDUCER, PITTED

FIGURE 9

PITTING OF TYPE 316 WEIR BOX OUTLET IN THE TCA TOWER

FIGURE 10

STRESS CORROSION OF CARBON STEEL CLAMP IN VENTURI AFTERSCRUBBER

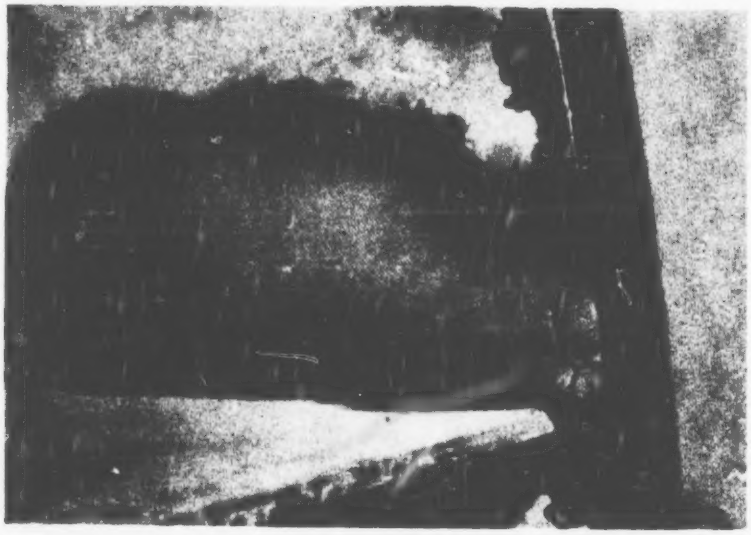


FIGURE 11

CRACK ABOUT 4 INCHES LONG IN SHROUD OF I.D. FAN
IN THE VENTURI SYSTEM

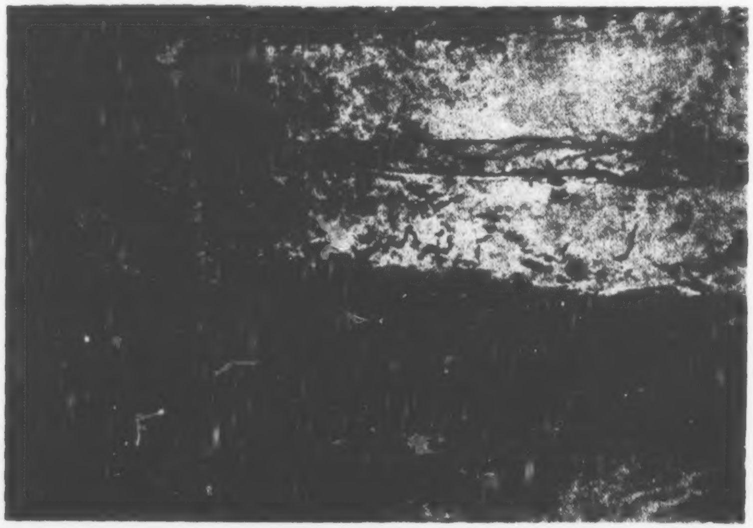


FIGURE 12

TYPE 316 EXPANSION JOINT ABOVE I.D. FAN
IN VENTURI SYSTEM—CORRODED AND CRACKED

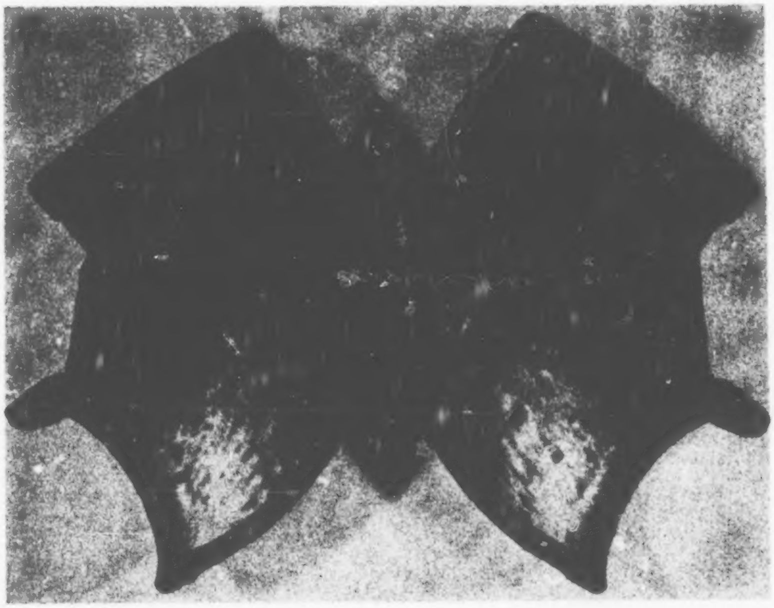


FIGURE 13

BLISTERS IN NEOPRENE LINING OF 4-INCH SLURRY LINE
IN SERVICE 623 DAYS